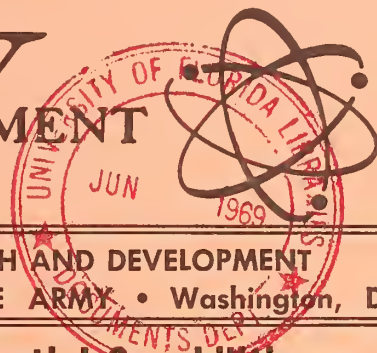




# ARMY RESEARCH AND DEVELOPMENT



MONTHLY NEWSMAGAZINE OF THE OFFICE OF THE CHIEF, RESEARCH AND DEVELOPMENT

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## USAR R&D Units Yielding To Mob Des Change June 30

Inactivation of the U.S. Army Reserve Research and Development Units, which at their peak consisted of more than 1,700 members in 74 units in 32 states, is scheduled June 30 in favor of "improved utilization" by Mob Des Unit reassignments.

Established in 1947 under Army Regulation 140-35 supplemented by SR 140-192-2, the USAR R&D Units were created to develop technical knowledge through active participation in the Army R&D program; also to utilize the scientific, engineering, technical and administrative skills of members.

Successive Army Chiefs of Research and Development have sponsored the program and have aggressively supported it by speaking at numerous scientific symposia and meetings throughout the nation.

Currently being coordinated is a new AR 140-70 that will detail the procedures and policies for transfer from the USAR R&D Program to the Mobilization Designation Program. Lt Col William D. Guinn, assistant executive, Office of the Chief of Research and Development, is coordinating the Mob Des changeover.

Originally it was planned that Mar. 31 would be a cut-off date for submission of applications from USAR R&D Units for Mob Des assignments.

(Continued on page 4)

## Resor Approves 3 Exceptional Civilian Service Awards

Secretary of the Army Stanley R. Resor approved Exceptional Civilian Service Awards early in April for three scientists in recognition of outstanding basic research achievements.

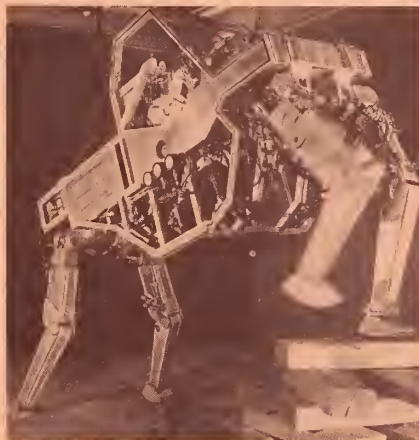
Dr. Julius E. Uhlener, Dr. Gunter F. Bahr and Dr. Gustavus H. Klinck will be honored at ceremonies before their coworkers in the near future. Dates of

(Continued on page 8)

## Quadruped Demonstrates Potential Capabilities

Department of Defense-industrial joint developmental effort sustained over several years to explore feasibility of a Quadruped machine with potential application to a broad variety of military and civilian materials-handling and mobility problems achieved a prototype demonstration Apr. 2.

The 3,000-pound experimental unit, using levered locomotion, combines its operator's dexterity, brainpower and all-around versatility with a machine's strength, size and ruggedness—and looks like out of "The Weird World of Tomorrow."



Quadruped machine prototype

### Featured in This Issue . . .

Chief of R&D Betts Cites Military-Industrial Relations Benefits	p. 2
ARO-D 1959 \$14,000 Basic Research Grant Returns Big Payoff	p. 10
MERDC Nominates 16 Employees for CO Special Achievement Awards	p. 12
Army Defines Environmental Pollution Control in AR 11-21	p. 14
WECOM Adopts Microfilm System for Catalog Data Retrieval	p. 17
Campuses Turbulence Tears at Traditions—By Dr. McClelland	p. 18
U.S. Army Helps Chile Procure Dental Vans for Remote Areas	p. 27
Chief of R&D Discusses AHFRAC Accomplishments	p. 36

An advanced system of levers, control linkages and servomechanisms serves to mimic and amplify movements of the walking machine's operator. His right arm controls the right front leg of the unit, his right leg moves the right rear leg of the machine; similarly, his left arm and leg control the left legs of the machine.

Many of the capabilities of the advanced prototype were first reported in the April 1967 edition of the *Army Research and Development Newsmagazine* in an article authored by Ronald A. Liston, published originally in *The Military Engineer* and reprinted by permission.

Liston has served since 1960 as  
(Continued on page 3)

## CE Studies Use of Laser To Control Weeds in Water

Laser beam control of aquatic weed infestations in navigable waterways is being investigated by the U.S. Army Corps of Engineers in a series of experiments to develop eradication methods minimizing side effects harmful to other plant life, fish, wildlife and water quality.

The concept of using specially designed lasers to cope with a continuing problem for which the Corps of Engineers has had responsibility since 1900 was developed by Dr. Ralph A. Scott Jr., chief of the Corps' Aquatic Plant Control Program. Use of chemicals and insects to control weeds in waterways also is being studied.

Disclosure of technical details of the laser process has been made to the U.S. Patent Office. The invention title is "Use of Laser Energy for Plant Eradication and Selective Control." Dr. Scott has signed a license granting exclusive use to the government, on a royalty-free basis.

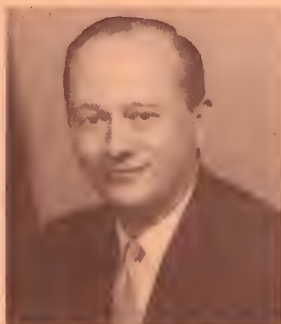
Preliminary tests have demon-  
(Continued on page 6)



Dr. Gunter F. Bahr

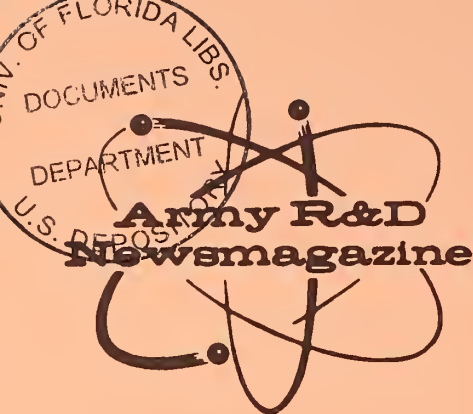


Dr. Gustavus H. Klinck



Dr. Julius E. Uhlener





## Betts Cites Military-Industrial Team Benefits

*Mounting criticism of the military-industrial relations in recent months has prompted Army Chief of Research and Development Lt Gen Austin W. Betts to speak out in defense of "cooperation." His recent address to the Northern New Jersey Chapter, Association of the U.S. Army, gained attention in Time magazine, Newsweek and other media.*

Relative to military-industrial cooperation, he said: "We have a mutually held conviction that our joint efforts contribute significantly to the national security. . . . Is there anything wrong about that?"

After citing numerous accomplishments attributable to military-industrial cooperation that have proved of profound importance to the nation's military and economic welfare, General Betts indulged in "a little bit of star-gazing . . . of what the Army of the future may very well be if we have the . . . resources we will need to develop ideas that now seem to be technically feasible."

"Within the lifetime of those of us pointed out, television has reached full stature after being unveiled as an oddity at the New York World's Fair. Similarly, the simple mechanical calculator has emerged full blown as the genesis of the worldwide multibillion-dollar computer industry.

The "marvel" of the aircraft industry about 30 years ago was an improved DC-3 airplane, capable of 196 mph and a trip across the country, good weather permitting, in about 20 hours. Rocket propulsion was used only to provide spectacular fireworks on the 4th of July. Trips to the moon—fanciful flights for Mother Goose Nursery Rhymes!

General Betts cited, as one example of the economic growth and progress that is as certain as tomorrow—due to the technological explosion set off by military-industrial cooperation—the recent statement by the president of General Electric Co. that GE now has more scientists and engineers working in aerospace alone than were employed in the entire company 20 years ago.

Another illustration he used to point to the dramatic possibilities of future technological progress was the recent statement by an official of DuPont Co. that by 1980 one-half of the company work force will be making or selling products unknown in 1965.

"Within the lifetime of those of us in this room," General Betts said, "it will probably be possible to fly from New York to Tokyo in less time than it took in 1940 to drive from New York to Washington. With rocket propulsion, travel time from New York to Tokyo could be less than one hour.

"I make this comparison between

today's and yesterday's world to give you some feeling for the magnitude of the problems we face today.

"Somehow, from this vast cornucopia of technological advances, we in Army Research and Development must select those that will be most important to the Army of tomorrow. . . .

"Today product improvement for military weapons and equipment must be considered an unacceptable compromise, so great are the alternatives offered us from today's technology. . . .

In a logical approach to reduce the "wish list" to only those items that can stand the test of objective system analysis, General Betts referred to the Army's new "Troika" organization.

This unites and integrates programming and evaluation efforts of the U.S. Army Combat Developments Command through its Institute of Land Combat, the Army Materiel Command through its Advanced Materiel Concepts Agency, and the Assistant Chief of Staff for Intelligence through its Threat Analysis Group.

"While the Army R&D budget of almost \$2 billion seems like a vast sum of money—and it is indeed larger than the entire federal budget of 1915—it very definitely has its limits.

"Almost a third of this must be allocated to ballistic missile defense. Another third is used to support the necessary base of research and technology and to pay for testing and evaluation of the things we develop.

"What remains is available to support the requirements of the Army in the field. When you think in terms of antitank missiles costing thousands of dollars each, albeit there is a great increase in effectiveness, there is a limit to the systems we can undertake to develop. . . . We cannot afford to clutter up the supply and maintenance channels with items that do not pay their way in combat effectiveness."

General Betts then launched into a discussion of "things that are technologically feasible, if we have the resources to develop them, and if we can thoroughly justify the effort. . . . I'll put these systems into the five broad categories of detection-surveillance, firepower, mobility, communications-command and control, and combat support."

Visualizing a tactical situation in  
(Continued on page 34)

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**Purpose:** To improve informal communication among all segments of the Army scientific community and other Government R&D agencies; to further understanding of Army R&D progress, problem areas and program planning; to stimulate more closely integrated and coordinated effort among Army R&D activities; to express views of leaders, as pertinent to their responsibilities, and to keep personnel informed on matters germane to their welfare and pride of service.

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# Quadruped Demonstrates Potential Capabilities

(Continued from page 1)

chief, Land Locomotion Division, U.S. Army Tank-Automotive Command, Warren, Mich., and has been project engineer of USATACOM's Quadruped Walking Machine Program (QWMP). In 1967 he was awarded a Secretary of the Army Research and Study Fellowship for advanced research in soil mechanics.

Successful demonstration of the prototype at the General Electric Co. Research and Development Center, Schenectady, N.Y., rewarded developmental effort sponsored jointly by the Advanced Research Projects Agency (ARPA), Department of Defense, and the Department of the Army. USATACOM has acted as contracting agency and provided technical supervision for the U.S. Army Materiel Command.

In an initial series of tests, the research prototype has walked across level ground, turned around, climbed obstacles, lifted a small military vehicle out of a mud hole, and hoisted a 500-pound load onto a truck with one foot, thereby impressively indicating its potentialities.

The "force feedback" control system of the quadruped is engineered so that proportions of the forces generated or encountered by the machine are duplicated and reflected to its operator, whose control power is amplified by the system.

If the machine strikes a solid object, the operator feels a proportional force within his arm or leg controlling that part of the unit. Because of this "sense of feel," he can be blindfolded and still operate the unit successfully. In the 1967 *Army R&D Newsmagazine* article, Liston pointed out that "a force miscue is not possible because the force is based on gravity or acceleration."

The operator can maneuver the machine forward or backward, balance it on two diagonal legs, make it climb over a 4-foot-high obstacle, walk it along a narrow pathway, or skid a 1,000-pound load across the ground, test engineers have reported.

Results of performance tests with the quadruped were discussed in a paper presented at the 1968 Transportation Engineering Conference sponsored by the American Society of Mechanical Engineers and the New York Academy of Sciences.

Liston and Ralph S. Mosher, a consulting engineer in GE's Specialty Materials Handling Products Operation in Schenectady, coauthored the paper. Mosher is a developer of "force feedback" control and an interna-

tional authority on Cybernetic Anthropomorphous Machine Systems (CAMS), in which GE has pioneered.

"It is quite possible to pose many situations in which walking devices have superior performance potentials to conventional vehicles: climbing extreme slopes, negotiating river banks, fording fast-moving streams, and so on," Liston stated. "The list is limited only by the imagination."

Researchers believe the greatest potential of the Quadruped may be in handling materials under peculiarly difficult conditions where present equipment falls short of meeting requirements. The exploratory development work represents a very serious effort in a long chain of advances that have increased man's capability to lift and move heavy objects.

The outstanding feature of the Quadruped is its system of sensors and controls, enabling the operator to manipulate the "arms" and "legs" of the machine as though they were extensions of his own arms and legs—but with greatly amplified force and range.

The prototype is 11 feet high and can move along level ground at about five miles an hour with a 500-pound load. Initial tests have been performed indoors on a sand floor. Additional indoor tests are scheduled

## Gribble Assumes Command of Army Engineer Center

Maj Gen William C. Gribble took command of the U.S. Army Engineer Center and Fort Belvoir, Va., Apr. 15, after serving since July 1967 as Deputy Assistant Chief of Staff for Force Development, HQ DA. Prior to that assignment he was Deputy Chief of Research and Development, HQ Department of the Army.

He was chief, Development Division, Army Materiel Command (AMC) from November 1963 to May

before the unit is field tested. The latter tests will indicate what type of special CAMS capabilities would have to be designed into future quadruped machines to operate in extremely rough terrain.

To keep development costs at a minimum, the machine was designed to provide just enough maneuverability to test the feasibility of the man-amplifier concept in a 4-legged unit. The three motions in each leg are limited in amplitude; there are no ankle or leg-twisting motions.

The human leg, by way of comparison, has eight distinct motions, supplemented by three motions of the pelvis. Now that basic feasibility has been demonstrated by the prototype, the joint developmental team said, additional motions can be studied to increase the Quadruped's versatility.

The Chief of Research and Development regards the present prototype as a tested for further study of the forced-feedback principle to provide increased capabilities for military functions other than mobility.

Scientists expect R&D expenditures to increase man's capability to lift and move heavy objects, and to maneuver over rough terrain, will be repaid many times in cost savings and effectiveness of military and civilian applications. Industry already has applied the forced-feedback principle to assembly line manipulators and load lifters in foundry operations.

1964, until promoted to AMC Deputy Director, and four months later became director of AMC Research and Development.

From 1961 to 1963, General Gribble was chief, Army Nuclear Power Program, and later was deputy director of Military Construction, Office of the Chief of Engineers.

Following an assignment as deputy assistant director, Reactor Development Division, U.S. Atomic Energy Commission in Washington, D.C., he was awarded the Legion of Merit in 1957. He was cited particularly for developing the technical specifications for design, construction and test operation of the Army's first nuclear power plant at Fort Belvoir.

Graduated from the U.S. Military Academy in 1941, he served with the 340th Engineers as regimental supply officer and company commander during construction of the Alaskan Highway. Then he was executive officer of the unit in the Southwest Pacific Theater of Operations.

In 1946 he earned a master's degree in physical science from the University of Chicago and from 1948 to 1952 was a metallurgical engineer with the Los Alamos Scientific Laboratory.



Maj Gen William C. Gribble



# USAR R&D Units Yield to Mob Des Change

(Continued from page 1)

Lt Col Guinn stated this date will be extended indefinitely to enable as many as possible of the some 1,200 USAR R&D Unit members to be transferred to the new R&D Officer Career Program. AR 140-70 will become effective July 1.

The notice mailed to all USAR R&D Unit members emphasized that:

"The inactivation of the USAR R&D Units does not change your status as members of the Ready Reserve. You are still members of the Immediate Ready Reserve (IRR). For obligated officers, unless you have a Mob Des assignment, you will probably be reassigned to fill troop requirements according to the Reserve requirements in your locality. . . ."

Reservists thinking about Active Duty training will have no problem if assigned to Mob Des Units, but in 1969 there will not be any of the seminars and conferences that were conducted as part of the USAR R&D Unit Program.

Requests for organizing Mob Des Detachments as a follow-on to USAR R&D Units must be submitted through the area commander (ARCOM) to the U.S. Army Administration Center, 9700 Page Boulevard, St. Louis, Mo. 63132.

The draft of AR 140-70 states that if no suitable Mob Des vacancy exists for officers otherwise qualified for participation in the Mob Des Program, they can be accepted contingent upon acceptance by a proponent agency in a non-R&D Mob Des position. Assignments of such officers will be reviewed periodically to determine if there is a suitable R&D Mob Des to which they might be transferred.

While no organizational structure is prescribed for Mob Des detachments, the policy is "the organization should facilitate training in the mission of the proponent agency or agencies of the attached officers." It further states that "appropriate latitude will be afforded in training programs."

Pointed out in the letter to USAR R&D Unit members is that one of the greatest weaknesses of this program is that officers "lack full knowledge of Army R&D activities" and that "OCDR is not staffed to perform the administration and training" activities. It is further explained that:

"The records of officers in USAR R&D Units who do not have Mob Des assignments, in general, are not as complete as officers who train regularly in Mob Des assignments. Without a Mob Des assignment, an officer in the IRR does not have op-

portunity to demonstrate potential or to develop his ability as a staff officer in the DA or other high-level headquarters."

The new R&D Officer Career Program is designed for officers "who possess a highly specialized educational background, technical experience and professional qualifications for selection as participants."

Objectives of the program include:

- Provide a means for utilizing USAR officers with scientific and technical training and experience during peace time to further the Army's R&D mission.

- Fulfill requirements for R&D officers in the event of a partial or general mobilization resulting from a declaration of war or national emergency.

- Identify positions in Mobilization

## APG Sites Big Computer

Near the site where the world's first electronic digital computer, the ENIAC, was put into operation in 1947 at the U.S. Army's Aberdeen (Md.) Proving Ground, a large-scale, general-purpose, third-generation computer was activated Mar. 27.

The ENIAC was in Building 328 and the new IBM 360-65 is in Building 310, in what is known as the computer center of the Management Science and Data Systems Office. Two remote terminal units are in the Materiel Test Directorate and the U.S. Army Ordnance Center and School. The computer units serve the APG and tenant organizations.

Designed to standardize all installation management systems and programs, the new computer will eliminate the necessity for separate organizational systems, such as payroll, cost accounting, supply management, personnel management, work planning and control.

The 360-65 unit has a storage capacity for 256,000 characters of information and is capable of accommodating an increasing complexity and volume of scientific and engineering applications in addition to routine business-type computations.

Brig Gen Michael Paulick, deputy CG of the U.S. Army Test and Evaluation Command (TECOM) officiated at the activation ceremonies. Observers included Brig Gen Charles D. Y. Ostrom Jr., CG of the Ordnance Center and School; Col George C. Clowes, APG commander; and Col Ralph J. Hanchin, former chief, Management Science and Data Systems Office, TECOM, but now assigned to the U.S. Continental Army Command.

Under the Test Evaluation Anal-

Tables of Distribution of the DA staff, select major commands reporting directly to HQ DA, and other Department of Defense and governmental agencies, to be designated as R&D mobilization positions.

- Identify, select and assign to R&D Mob Des positions highly qualified officers with scientific and/or technical training who are available and capable of immediate and effective performance.

- Provide a means through proponent agencies for conducting continuous and effective training, and keep R&D officers abreast of technological changes and developments applicable to the Army.

- Provide incentives that will encourage maximum participation of R&D officers in the program over a long period of time.

- Provide a system of individual career management for each officer on matters of career advancement.

## Near World's First

ysis Management Uniformity Plan (TEAM-UP), the APG computer installation was designated as the prototype for evaluation prior to procurement of similar equipment for other U.S. Army installations.

## Management School Hits Total Of 6,875 in Installation Course

Graduation ceremonies recently at the U.S. Army Management School for the 142d class of the Army Installation Management Course raised to 6,875 the number of students who have completed this training.

The course was first offered in November 1954. Since then, it has given participants, mainly from the Army but also some from the Navy, Air Force and Marine Corps, a unique opportunity for personal development. The 3-week course is conducted for 54 officers (majors through colonels) and Civil Service personnel (GS-11s and above) eight times each year.

Discussion in small groups of 9 to 12 participants, each group having its own faculty adviser, accounts for about 40 percent of the course content. Full-class participation accounts for the remaining 60 percent, consisting of faculty-led lectures and conferences, closed-circuit TV, films and guest speakers.

## Contract Let for AMRAD Work

Operation and maintenance of the AMRAD radar facility at White Sands (N. Mex.) Missile Range will be conducted under a \$2.5 million contract awarded to the Riverside Research Institute of New York City. Completed in 1963, AMRAD is used primarily in the U.S. Air Force's Advanced Ballistic Reentry Systems program involving the Athena missile.



# Emulsified Fuels Progress Review Scheduled May 5

Progress reports on development of emulsified fuels as a medium for reduction of the fire hazard in aircraft crashes and in use of other Army materiel are scheduled at a May 15 meeting at the Army Fuels and Lubricant Laboratory (AFLI), San Antonio, Tex.

Pros and cons of emulsified fuels versus crashworthy fuel systems (CWFS) will come up for consideration, following a report by the Army Aviation Systems Command on what the \$34-million CWFS retrofit program is expected to accomplish. AVSCOM will detail short- and long-range objectives, and indicate decision points.

The U.S. Bureau of Mines, which has been much interested in the Army emulsified fuels program, is preparing a proposal for cooperative effort. A bibliography of reports and a total status report of ongoing programs will be prepared by the AFLI as host to the meeting.

Representatives of the majority of Army agencies interested in the emulsified fuels and crash-worthy fuels developmental efforts are expected to participate in the discussions.

As a preliminary to the sessions at San Antonio, an intra-Army conference on emulsified fuels was held recently at the U.S. Army Research Office (USARO), Arlington, Va. Dr. Thomas E. Sullivan, chief, Materials, Sciences and Technology Branch, Physical and Engineering Sciences Division (P&ESD), Office of the Chief of R&D, presided.

Twenty-five work status resumes were reviewed by 17 representatives of OCRD and the Army Materiel Command. Reports covered efforts of Army in-house laboratories and industry to determine combustion characteristics of various emulsified fuels. Feasibility of using these fuels in aircraft turbine engines to prevent post-crash fires was discussed on the basis of current developmental test results.

The group developed a \$350,000 FY 69 Emulsified Fuel Program that includes activities in crash environmental safety and fuel-safety characteristics. Additional safety definition work, physical and chemical definition of fuels, investigations concerning UH-1D helicopter system compatibility, and exploration of on-board demulsification and emulsified fuel cleanup techniques are programmed.

Tentative plans were established for a FY 70 Program to include safety and vulnerability work, design of a continuous process field emulsification unit, studies on compatibility, further efforts on techniques and demulsification unit application.

Other OCRD representatives included Lt Col Louis G. Klinker and Richard Ballard, P&ESD, USARO, Lt Col Donald A. Nixon and Maj William H. Edwards, Air Mobility Div.

HQ AMC representatives included Ronald E. Streets, George W. Johnston, and E. D. Proudman. AMC command and central laboratories were represented by John D. Grabski, U.S. Army Mobility Equipment R&D Center, Fort Belvoir, Va.; Dr. John

W. Dawson, U.S. Army Research Office-Durham, N.C.; and

E. V. Merritt and W. J. Nolan, U.S. Army Aviation Laboratories, Fort Eustis, Va.; C. F. Pickett and C. F. Schwarz, Coating and Chemical Laboratory, Aberdeen Proving Ground, Md.; and W. H. Brabson, U.S. Army Aviation Systems Command, St. Louis, Mo.

J. Terry Gray represented the Army Fuels and Lubricants Research Laboratory and the Southwest Research Institute, San Antonio, Tex.

## ARO-D Seeks Summer Jobs for Professors in Army Labs

Services of highly competent scientists and engineers, at the professorial level in colleges and universities, may be available to Army in-house laboratories this summer through a program sponsored by the U.S. Army Research Office-Durham (ARO-D), N.C.

The ARO-D Laboratory Research Cooperative Program was activated during the spring of 1968. Last summer 52 scientists and engineers in 42 academic institutions participated in research at 13 Army in-house labs.

The purpose of this ARO-D program is to provide a mechanism whereby exceptionally capable college or university professors can assist within Army laboratories, working side-by-side with U.S. Government employees.

The concept is that the visiting professors will have an opportunity to gain first-hand information on meaningful Army R&D activities; also, that they will be able to instruct government employees in the most recent scientific findings and technology produced by academic research.

Under no circumstances will the temporary employees from the academic institutions supplement the normal installation research staff in the pursuit of routine duties requiring continued attention over extended periods. The assistance will fall preferably during the extra-academic period.

ARO-D is currently seeking Army in-house laboratory participation in the coming summer program. Any Army command installation or agency desirous of participating may request ARO-D to provide the professors for a limited period "in the pursuit of mission-related research in its laboratory and in cooperation with members of its technical staff."

Requests concerning participation in the program should be submitted directly to ARO-D. Funds must be transferred to ARO-D to cover all expenses involved. Notice of need should be provided to ARO-D as far in advance as possible. ARO-D will in turn authorize that this assistance be obtained under a contract specific to this purpose.

## Army Commissioning Oral Health Managers

The first Military Community Oral Health Managers (MCOHM), recruited in a new program to improve effectiveness of dental care, will be commissioned in July as U.S. Army Medical Service Corps officers.

Approved Feb. 13 by the Department of the Army, the program began with selection of 25 officers who will be assigned to the Medical Field Service School, basic training centers, large military installations, and the U.S. Army Europe.

The MCOHM officers, second lieutenants to captains, will assist dental officers in a wide range of activities, including preventive dentistry for optimal oral health of soldiers and their families. They will enable career Dental Corps officers now engaged in community relations activities to devote their major effort to direct patient care.

With a broad and imaginative ex-

pansion of duties and responsibilities normally assigned to dental hygienists, the MCOHM will be concerned with patient-education programs at Army posts and worldwide stations. They will be expected to develop new and improved approaches for programs to motivate proper self-care oral health practices.

The program exemplifies the concern of the U.S. Army Medical Department in helping to meet public health problems by using auxiliary personnel in all activities not requiring the professional knowledge or skills of a dentist or physician.

Requirements for commissioning in the new program are either a bachelor's degree from an approved 4-year dental hygienist program, or graduation from an approved 2-year dental hygienist program combined with a bachelor's degree in education, public health, or another health-related field.



# Corps of Engineers Studies Use of Laser to Control Weeds

(Continued from page 1)  
strated feasibility of the concept, using the powerful laser in the Physical Sciences Laboratory at Redstone (Ala.) Arsenal, HQ U.S. Army Missile Command.

Research is continuing to determine the most effective level of exposure. Early experiments in May 1968 achieved the desired results on aquatic weed specimens with 1,350 watts at 1.9 seconds exposure. More recent investigations have yielded immediately visible damage with 650 watts of power and .025 seconds of exposure.

The patent disclosure describes the eradication method as "based upon the induction of phytotoxic and system responses in plants subjected to laser energy, and the use of this unique discovery to eradicate and selectively control plant weed problems."

Anticipated applications of the method include control of weeds (floating-emerged and submerged plants) along inland and coastal waterways as well as in marshes and marginal lands bordering waterways.

Other applications might include control of weeds along roadways, railroad right-of-ways, vacant or "soil-bank" land resources, truck-farm operations, and water supplies where this means of control is favored over use of chemical eradication systems. The patent disclosure states:

"The method can be modified by selection of the proper laser energy so that weed control can be both on land or at the water surface, and also below the water surface for control of suspended and bottom-rooted plants."

Practical instrumentation required for field control of weeds and the operational parameters to accomplish this objective are currently being developed by the Corps of Engineers in coordination with the Army Missile

Command under contract with Athens (Ala.) College and Auburn (Ala.) University.

Development of the most desirable prototype equipment, in Dr. Scott's opinion, "may be one to two years away." Envisioned is equipment that may be used when mounted in a boat or carried by low-flying aircraft.

Corps of Engineers Chief Scientific Adviser Dr. Gilford G. Quarles has been assisting Dr. Scott in arranging for the exploitation of the laser aquatic weed control concept. Technical assistance on lasers also has been provided by Dr. Harold Gibson of the Army's Harry Diamond Laboratories and by Edwin N. Myers, staff assistant for electronics components of lasers, infrared and night-vision devices, Office of the Director of Defense Research and Engineering.

Dr. Thomas A. Barr, chief of the Plasma Physics Branch, Buford Jennings of the MICOM Physical Sciences Laboratory and Harold Blodgett, former Army Materiel Command coordinator for laser projects, are among others who assisted in arranging and conducting experiments. Dr. Richard Couch, professor of biology at Athens College, is a contract project officer for cytological support.

Dr. Scott said that plant response to the laser exposure in experiments has been much like that which could be caused by quickly passing a blow torch over the leaves. They wither, but this would not be a lethal response. Inactivation of the enzymes in the systemic process is what apparently causes the death of the plant 8 to 12 weeks later.

Diffraction of the laser beam to spread it out to a width of about one foot for plant eradication purposes was achieved by the use of gold colloidal mirrors in the preliminary experiments, Dr. Scott said.

The idea of using a laser device as



**Figure 2. WATER HYACINTH BULBS** in second week of decomposition after exposure to laser beam used in investigations to control aquatic weed infestations in navigable waterways. Various stages of decomposition can be seen in photo by tonal values of the bulbs, from early decay (center, left) to decomposed stage seen around the edge of the container.

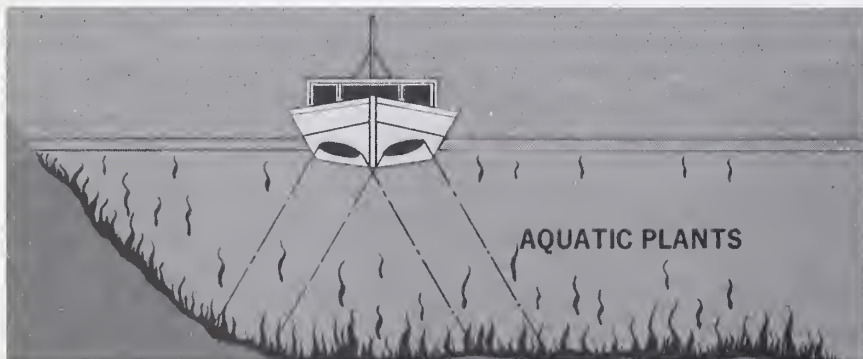
a method of controlling weed infestations occurred to Dr. Scott while he was employed at the Army's Deseret Test Center, Salt Lake City, Utah, about two years before he transferred to the Corps of Engineers in his present job in June 1967.

**Chemical Control Methods.** Concepts he has been exploring in the Corps of Engineers aquatic weed control activities have included better control for chemical methods.

One of his original ideas is titled "Complex Custom Control Method" for use of multi-purpose biocides and herbicides. This concept has been advanced to the exploratory stage. He has a related concept for a "Complex Custom Control Method for Industrial Water Pollution Control" that has not reached the experimental phase.

Edgewood (Md.) Arsenal scientists (principally Lt Col William Barnes, chief, Entomology Division, U.S. Army Environmental Health Agency) have been working with him since October 1968 in exploring the feasibility of "stability control" in the use of biocides and herbicides for water pest control operations. Cooperating in this effort is the U.S. Department of Agriculture installation at Fort Lauderdale, Fla.

This concept involves development of a sophisticated carrier system that permits confinement of herbicides used in weed eradication to selected depth zones. Dispersal to an entire water environment is avoided. Slow



**Figure 1. Concept of Laser Eradication System** mounted in boat to control submerged-suspended and bottom-rooted aquatic plants in navigable waterways.



release of herbicidal and other chemical agents is spread over a period of more than a year "and may be tailored to fit any specific situation."

Acceleration of the Corps of Engineers long-sustained aquatic weed program started in 1958, when Congress recognized the rising national importance of the problem. Section 104 of Public Law 85-500 authorized a substantially expanded control effort.

In response, the Corps of Engineers submitted to the 89th Congress an "Expanded Project for Aquatic Plant Control," House Document No. 251, which was referred to the Committee on Public Works, in July 1965.

Congress authorized appropriation of funds not in excess of \$5,000,000 annually, as necessary, to conduct the expanded program, which was implemented under provisions of Chief of Engineers Circular No. 1165-2-16.

The Chief of Engineers administers the weed control program under direction of the Secretary of the Army, in cooperation with United States and state government agencies. Among the federal agencies are the Department of Agriculture, Public Health Service, Fish and Wildlife Service, Tennessee Valley Authority, and the Water Pollution Control Administration.

Results of the control program, in the opinion of Corps of Engineers officials, have yielded a high rate of return for monies expended. With respect to control of water hyacinths and alligator weeds, treatment of some 200,000 acres of infested waterways at a cost of \$4 million in 1965 was estimated to have saved \$14 million annually "for as long as reinfestation does not occur."

**Weed Destroying Insects.** Argentine flea beetles have become one of the most effective means of controlling alligator weed. In 1964 they were

*Dr. Ralph A. Scott Jr., one of the U.S. Army's younger scientists who has been gaining recognition rapidly since he became chief of the Corps of Engineers' Aquatic Plant Control Program in June 1967, received his PhD from Texas A&M University in 1957.*

*He earned a 1952 degree in biology and chemistry from the University of Illinois and an MB degree in plant physiology and organic chemistry from the University of Oklahoma in 1953. Following postdoctoral work at the University of California at Los Angeles, he pursued advanced studies at the Oak Ridge, Tenn., facilities of the U.S. Atomic Energy Commission.*

*Dr. Scott was chief of the Division of Chemistry, Department of Public Health, Washington, D.C., as a Federal Civil Service employe for 18 months (1966-67) following an 8-month tour doing classified research at Deseret (Utah) Test Center. After five years (1958-63) with the U.S. Department of Agriculture as a research plant physiologist, he was chief chemist at Holloman Air Force Base for 2½ years.*



called a "serious impediment to navigation and stream flow in 3,000 miles of inland waterway in eight southeastern states from North Carolina around to Texas."

Importation of the beetles followed four years of experimentation to determine effectiveness in checking growth of the weed, as well as the possible adverse results. Results have proved highly satisfactory, Dr. Scott said, in controlling the growth and spread of the weed.

Use of other species of beetles and insects from Argentina and Uruguay to control water hyacinths also is being studied. In a paper presented to the annual meeting of the Weed Science Society of America in Las Vegas, Nev., in February 1969, Dr. Scott said four species of beetles have shown an appetite limited principally to the hyacinth. Similar insects of watermilfoil are being studied in Pakistan and Yugoslavia.

Among other obnoxious aquatic plants the Corps of Engineers is en-

deavoring to control selectively are Eurasian watermilfoil, elodea, sea lettuce, water chestnut, phytoplankton and filamentous algae.

## MICOM's Essenwanger Chosen In International Who's Who

Dr. Oskar Essenwanger, an Army Missile Command physicist, has been selected to membership in the *International Registry of Who's Who* in recognition of personal achievement and prominence.

Dr. Essenwanger, chief of the Aerophysics Branch, Physical Sciences Laboratory, Research and Engineering Directorate, has published more than 60 scientific articles, reports, and book reviews in European and American journals, and has given numerous presentations before professional groups.

He is an associate Fellow in the AIAA, a senior member of the ASQC, a member of AMS, AGU, ASA, the Alabama Academy of Science, the German Meteorological Society, the German Verband Deutscher Meteorologen and is a certified consultant.

## AIC Recognizes ECOM Chemist

Dr. Benjamin C. Bradshaw, chemist in the Power Sources Division, Electronic Components Laboratory, and a 23-year employe of the Army Electronics Command, recently accepted an invitation for a Fellowship in the American Institute of Chemists.

Recognized for his contributions in physical chemistry, he has authored "A Study of Electrodes and Electrode Reactions" and numerous other technical reports, many of which have appeared in *The Journal of the American Chemical Society* and *Bulletin of the American Physical Society*.

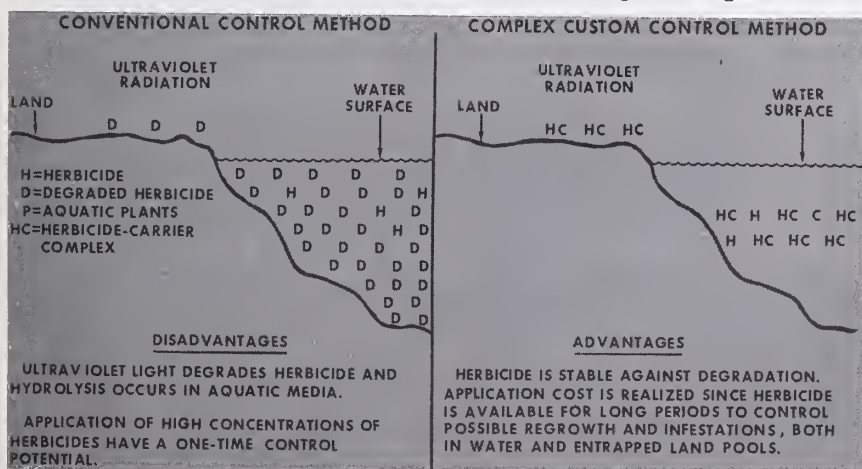


Figure 3. Aquatic Plant Control Systems (Herbicide Stability).



# Resor Approves Exceptional Civilian Service Awards

(Continued from page 1)

ceremonies had not been announced as this publication was submitted to the printer.

Dr. Uhlener has distinguished himself during a 21-year career in Army research and has been director of the Army Behavioral Science Research Laboratory (formerly the Army Personnel Research Office) since 1961.

The citation credits him with helping to "maximize the impact of psychometrics, experiential psychology, manned systems research and operations research as individual disciplines upon Army human factors. He demonstrated how such diverse scientific approaches could be integrated into a unified program of widened scope. . . ."

Scheduled to take office in September as president of Division 19 (Military Psychology) of the American Psychological Association, Dr. Uhlener has been active in programs of the division for 14 years. He has contributed two major publications recently, one on historical development of military psychology and the other on the state-of-the-art.

One of his notable achievements was the development of an original concept that led to the Armed Forces Qualification Test (AFQT). This is

the basic tool for determining assignment of military personnel according to capabilities and training potential. He also helped to establish the Officer Evaluation Center at Fort McClelland, Ala., and to develop the framework for Manned Systems Research.

Born in Vienna, Austria, in 1917, he emigrated to the United States and has been a U.S. citizen since 1928. He earned a BS degree from City College of New York in 1938, an MS degree from Iowa State University in 1941 and a PhD from New York University in 1947, when he started his career as an Army scientist.

In 1960 he was awarded the Meritorious Civilian Service Award, second only to the Exceptional Civilian Service Award as an honor conferred by the Army on civilian employees. He was an Army nominee for the prestigious Arthur S. Fleming Award in 1960, and has received various other awards.

Dr. Uhlener is a Fellow of the American Psychological Association in four divisions—Evaluation and Management, Industrial Psychology, Military Psychology, and Society of Engineering Psychology. He is a member of the Human Factors Society, Operations Research Society of America, Psychonomic Society, and

International Association of Applied Research.

Long prominent in various Army and Department of Defense special committees and ad hoc groups, he is currently a member of the Armed Forces National Research Committee on Vision, Highway Research Board, Human Engineering and Psychological Panel of the DoD R&D Board, Army Human Factors Engineering Committee, and the AHF R&D Committee.

DR. BAHR was cited for exceptional performance of duty as chief, Biophysics Branch, Armed Forces Institute of Pathology, from Dec. 1, 1966 to Nov. 30, 1967. He was credited with "an international reputation as a physician-scientist in the diagnosis, consultation, education and original research in the application of electron microscopy and related techniques to the study of cytological structure, function and morphology."

The ECS Award is based on "studies of rodent, avian and primate malaria that have resulted in significant advances in knowledge and technology, especially as they relate to military medicine. His achievements in his specialized field are an inspiration to all his associates."

Much of his recent work has been concerned with the malaria problem in Southeast Asia, where he has organized and directed various studies. Dr. Bahr is known for his work on the staff of the Nobel Institute for Cell Research from 1950 to 1960 and as associate professor at the Institute of Pathology at Karolinska Institute in Sweden. He also has been a visiting professor of pathology at Northwestern University.

Recognized as a prolific writer in his research field (79 medical publications), Dr. Bahr serves as a member of the editorial boards of *Laboratory Investigation* and the *Journal of Histochemistry* and *Cytochemistry*. He is associate editor of *Acta Cytologica*.

Born in 1922 in Hamburg, Germany, he was graduated from the University of Wurzburg in 1950 and remained there to earn a medical doctor degree in 1952. He was awarded an MD from Karolinska Institute in 1957.

Dr. Bahr received the Army Meritorious Civilian Service Award in 1963 and was a winner of an Army R&D Achievement Award in 1967. He was cited for his work in helping to develop an Integrating Photometer for research on dry-mass determination of electron scattering, and was active in establishing an AFIP laboratory now studying laser beam effects upon users of such equipment.

DR. KLINCK's selection for the

## Maj Gen Rasmussen Takes Command at WECOM

Leadership of the U.S. Army Weapons Command passed from Maj Gen O. E. Hurlbut to Maj Gen Henry A. Rasmussen, 53, following appointment of General Hurlbut as Army member of the Joint Chiefs of Staff Logistics Review Board, Washington, D.C., with promotion to 3-star rank.

General Rasmussen reported for duty at HQ WECOM, Rock Island, Ill., after serving as assistant chief of staff, Logistics J-4, U.S. Military Assistance Command Vietnam since 1967. He was director of Materiel Readiness, Logistics Division, HQ U.S. Army Europe until December 1966 and then was special assistant, Logistics, HQ Department of the Army.

Within the past 10 years he has been a member of the Ordnance Board at Aberdeen Proving Ground, Md., attended the Industrial College of the Armed Forces, and served two years as assistant to the director, Procurement, Office of the Deputy Chief of Staff for Logistics, HQ DA.

Following a tour of duty (1961-63) in the Office of the Special Assistant for Military Assistance Affairs, Office of the Joint Chiefs of Staff, he was assigned to command the U.S. Army

Ordnance Depot in Korea. Upon his return in July 1964, he was appointed deputy director, National Planning Group, Defense Supply Agency, Washington, D.C.

General Rasmussen received an ROTC commission upon graduating from the University of Minnesota with a BS degree in mechanical engineering, and was called to active duty in 1941. He earned an MA degree in business administration from George Washington University.



Maj Gen Henry A. Rasmussen



ECS Award is based on "exceptional performance of duty as chief, Endocrine Pathology Branch, Armed Forces Institute of Pathology from Dec. 1, 1966 to Nov. 30, 1967. . . .

An eminent physician-scientist-educator, he is considered one of the leading medical authorities in this field, and has won acclaim for "significant contributions to knowledge and understanding of endocrine pathology."

Various achievements in thyroid gland research have earned worldwide attention, as have his "unique method for interpreting disease or abnormal tissue" and his collection of "more endocrine tissue than any other known individual." Author or coauthor of 24 medical papers reporting on his work, he is much in demand as a speaker at medical schools and professional societies.

Dr. Klinck is a Founding Fellow of the College of American Pathologists,

Diplomate of the American Board of Pathology, and a member of the American Association of Pathologists, the American Goiter Association, and Rensselaer Polytechnic Institute Chapter, Society of Sigma Xi.

Graduated from the College of Charleston, S.C., with a BS degree in 1924, he earned a medical doctor degree in 1928 from the Medical College of the State of South Carolina. He served his residency at the University of Pennsylvania hospital, where he was also an assistant instructor of pathology for three years.

The next 17 years he spent at Albany (N.Y.) Medical College as a Eugene Littaurer Research Fellow, assistant and then associate professor, and from 1939-48 as director of laboratories. He also was concurrently (1940-48) the director of the Tumor Clinic at Samaritan Hospital, Troy, N.Y., and consulting pathologist at Rawling Sanatorium (1946-48).

## Medic Edits 'Diseases of Medical Progress' Revision

*Diseases of Medical Progress*, third edition, was published recently as the work of Col Robert H. Moser, chief, Department of Medicine, Walter Reed General Hospital, Washington, D.C.

This medical reference book concerning illness caused by drugs or other therapeutic procedures is representative of a project in which Col Moser became interested while serving in the mid-1950s as chief, Department of Medicine, in a small U.S. Army Hospital near Salzburg, Austria. Since then he has been collecting data on the subject.

In a preface to the book, he explains that his interest was aroused when, during routine daily rounds, "my ward officers presented three patients in sequence, each with divergent syndromes, yet with a single striking factor that was common to all. . . . In each instance, the syndrome had been induced by rational, widely accepted therapy which had been properly ordered and accurately administered."

Response to a paper he presented on the subject at the U.S. Army-Europe Medical-Surgical Conference in Frankfurt-am-Main, Germany, in March 1956, encouraged him to publish a 131-page book in 1959. Again, response helped to bring to his attention a tremendous amount of material available on the subject, leading to a second publication.

Fourteen other medics, all experts in their respective fields, were asked to assist in finding material for the new edition, which he edited into 16 chapters according to diseases of systems. Included are a chapter on psy-

chosemantics, a section concerning the affects of the physician's communication with the patient, and a drug index listing all drugs mentioned by generic and trade name.

Dr. F. Dennette Adams, Massachusetts General Hospital, writes in the foreword: "Once again . . . Dr. Moser's rich imagination, expressed in the title *Diseases of Medical Progress*, suggests the kinetic stream of proof of reverification, fact and fallacy, action and reaction with which the medical world today perforce must deal. . . . I can only repeat what I wrote in 1959:

"One would like to think that this book will find its way to the desk of every physician, and that each will study the pertinent section before initiating, for any of his patients, a therapeutic measure of whose dangerous potentialities he may not be fully aware."

## Dorchak Named Acting Product Manager at MICOM



Lt Col Steven Dorchak Jr.

Lt Col Steven Dorchak Jr. has been named acting product manager for the newly designated Air Defense and Coordination Systems Product Office at the U.S. Army Missile Command, Redstone Arsenal, Ala.

Configuration manager for the Redeye Project at Redstone Arsenal since 1967, when he earned a master's degree in industrial management from the University of Alabama, he has a BS degree from Duquesne University.

Since 1954, when he became a Nike Ajax battery commander in the 514th Missile Battalion near Boston, he has been working with missile systems. He has been assigned to Korea twice, completed the Army Command and General Staff College and taught military history to ROTC cadets at Indiana University.

## DDC Gets Documentation On New System Simulator

Systems and Software Simulator (S<sub>s</sub>) documentation was released recently to the Defense Documentation Center (DDC) by the U.S. Army Computer Systems Support and Evaluation Command (USACSSSEC).

The USACSSSEC awarded a contract in 1966 for the design and development of a simulation program to be used in the evaluation of computer systems, resulting in delivery of the S<sub>s</sub> and associated documentation in March 1968. A second contract was let in June 1968 for augmentation of S<sub>s</sub> in the form of support programs.

Following delivery of the support programs in October 1968, the USACSSSEC began a study of the S<sub>s</sub> system to determine the cost of using it to measure thruput capability of computer systems as compared to other available techniques. The general application of S<sub>s</sub> to the evaluation of many computer systems requires a non-existent extensive data base covering their characteristics.

An analysis of the cost to prepare the required data base and operate and maintain S<sub>s</sub> has shown that its use would be more expensive than benchmarks, and it appears that it would lengthen the procurement cycle. The USACSSSEC has decided to use the benchmark technique as its primary tool for analyzing thruput capability and does not intend to develop further the S<sub>s</sub> system at this time.

Requests for the documentation have indicated considerable interest in the S<sub>s</sub> program. Agencies and firms desiring the documentation may obtain it by applying to the Defense Documentation Center (DDC), Springfield, Va. 22150. Document numbers are AD-679269, AD-679270, AD-679271 and AD-679272.



# ARO-D 1953 \$14,000 Basic Research Grant Returns Big Payoff

Basic research funded initially at less than \$14,000 in 1953 by a U.S. Army contract with a nonprofit institute is yielding one of the most important comparative payoffs on record, as the lubrication key to spacecraft, missiles, weapons systems and other military and civilian needs.

Research and development administrators at the top-decision level frequently are tormented by the difficulty of logical determination in selecting—from thousands of proposals each year for funding support—those basic investigations that offer the best prospect of the rewarding payoff.

Sometimes the seemingly minor proposal, involving a relatively paltry expenditure of funds, is the one that, when favorably considered, produces the return with worldwide applications of incalculable, continuing benefit. Always there is the haunting prospect that one of these opportunities will be too lightly bypassed.

One of the "right" decisions was made in 1953 by the U.S. Army Office of Ordnance Research, redesignated in 1958 as the U.S. Army Research Office-Durham, N.C. (ARO-D), a Class II Activity of the Office of the Chief of Research and Development, HQ DA.

Dr. V. R. Johnson of the Midwest Research Institute, Kansas City, Mo., presented the basis for that decision when he submitted a research proposal titled "Friction Forces on Molybdenum Di-sulphide." Today, a great proportion of the extreme-duty dry-lubricant applications are making use of the advances in fundamental knowledge resulting from this research.

*Dr. Sudhir Kumar, associate director of the ARO-D Engineering Sciences Division, working in collaboration with Capt Cecil R. Attaway of his staff, compiled the information for the following report on results of Dr. Johnson's work. Mr. James J. Murray, director of the ARO-D Engineering*

*Sciences Division, was monitor for the project.*

The research proposal was prompted by an awareness of the increasing need for high-pressure, high-temperature lubricants. At that time a lack of understanding existed about the mechanism of solid lubricants.

Graphite was recognized in general as an excellent solid lubricant, except that high-altitude aircraft experienced extremely rapid wear on graphite brushes used in electrical systems.

Experimentally, it had been determined that graphite is a poor lubricant under vacuum conditions and that another solid lubricant, molybdenum disulphide ( $\text{MoS}_2$ ), yielded excellent results. The question: *WHY?*

Dr. Johnson proposed investigation of their basic mechanisms. Findings produced a whole new family of solid-film lubricants ( $\text{TaS}_2$ ,  $\text{WSe}_2$ ,  $\text{MoSe}_2$  and others), making possible solution of bearing design problems that up to that time had proved unsolvable.

Impact of Dr. Johnson's discoveries has benefited a great variety of technologies, ranging from those used in howitzer production to the latest Saturn V rockets that have launched astronauts on the epochal NASA Apollo Program flights in recent months.

U.S. technology, Dr. Kumar stated, has "derived many millions of dollars worth of benefits from this rather inexpensive basic research."

Graphite and  $\text{MoS}_2$  are layer lattice crystals and normally would be expected to exhibit similar lubricating behavior. Dr. Johnson's research showed that an adsorbed water vapor layer is essential for graphite lubrication; it works well under normal atmospheric conditions, but fails in a vacuum where a vapor layer is not available.

Further experiments established

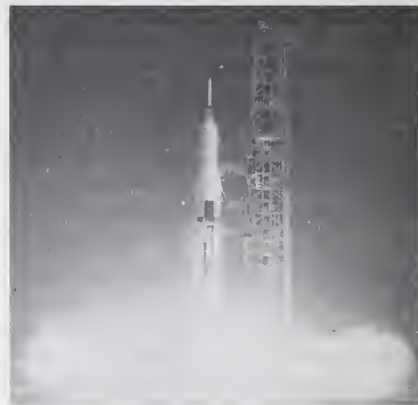


Fig. 1. Saturn IV, second-stage rocket that restarted in orbit, had gimbal lubricated by  $\text{MoS}_2$ -based lubricant.

that lubricating characteristics of  $\text{MoS}_2$  are due to an adsorbed sulphur layer. Adsorption is greater in a vacuum than under normal atmospheric conditions, making  $\text{MoS}_2$  an excellent lubricant under this condition.

A monolayer of sulphur adsorbed on the sulphur cleavage plane of the  $\text{MoS}_2$  crystal, because of its low bonding, is considered responsible for this lubricating quality. Evaporation of the sulphur layer under long-term vacuum conditions provides no difficulty, because a new layer is generated by abrasion upon resumption of sliding over the  $\text{MoS}_2$  crystals.

Dr. Gordon E. Gross of Midwest Research Institute has commented on Dr. Johnson's work, saying:

"The basic knowledge of the lubricating mechanism produced under the basic research programs resulted in MRI being able to begin immediately a long series of applied research and development programs for military and private industrial sponsors."

Results of this R&D effort are evident in almost every application of extreme-duty lubricants. Molybdenum disulphide is specified for military lubricants and the aerospace industry depends extensively upon its application to special requirements.

One of these uses, for example, was lubrication of the hold-down arms for the Saturn V space vehicle. Without this lubricant, developed specially under a contract with NASA, the hold-down arms could not have operated under rated load conditions. Launching of the spacecraft would have been extremely precarious, if not impossible, in the opinion of some officials.

Another application for the  $\text{MoS}_2$  lubricant is the RL-10 liquid-hydrogen liquid-oxygen rocket engine gimbal, a key part of the Saturn IV space vehicle. In its Saturn V applica-

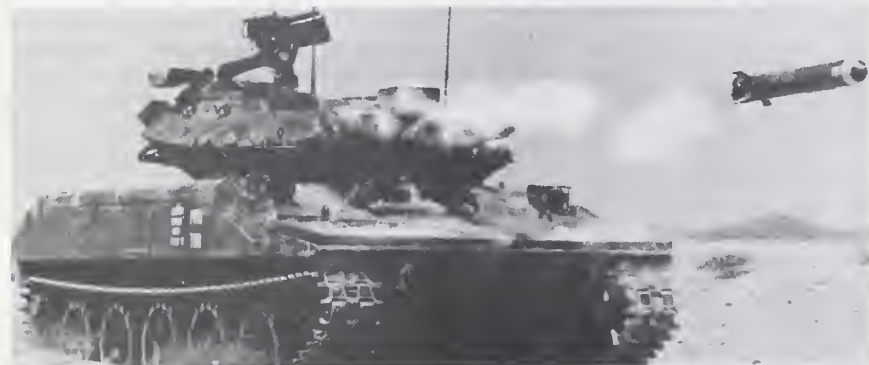


Fig. 2. Many parts of the Shillelagh rocket, shown being fired from an armored vehicle, are being dry-film lubricated with molybdenum disulphide.



tions, the Saturn IV restarts its engines in orbit and injects the Apollo spacecraft into a translunar trajectory.

This precise maneuver place extremely high demands on the MoS<sub>2</sub> lubricant; if it were to fail, the entire spacecraft could be lost. Figure 1 shows a Saturn I with a Saturn IV stage being used to launch the second meteoroid technology satellite, Pegasus II, into orbit.

Military applications of molybdenum disulphide lubricants are extensive. Watervliet Arsenal scientist T. O. Pochily reports that dry-film lubricants are used on gun tube recoil mechanisms and breech mechanisms with highly beneficial results. About 3,000 recoil mechanisms of the 155mm howitzer have so far been lubricated in this manner prior to their shipment from Watervliet.

One of the most significant advantages of using molybdenum disulphide as a lubricant is its excellent corro-

sion resistance when used in a dry-film application. Graphite lubricants absorb water and thus speed corrosion.

Important also is that use of a dry-film lubricant normally makes it unnecessary to lubricate the equipment again in the field. The result is improvement in cleanliness of the lubricated parts, extended service life and decreased down-time for maintenance.

Molybdenum disulphide lubricants' greaseless operational characteristics, Pochily stated, cannot be overemphasized with respect to maintaining cleanliness of equipment, since the dry film does not collect dirt as do petroleum lubricants.

This characteristic has led the U.S. Marine Corps to use it for lubricating two experimental XM 165 howitzers in Vietnam. Preliminary results of the dry-film lubricant are reported to be excellent, with respect to service life as well as minimum maintenance.

## Pershing 1A Completes Initial Production Tests at APG

Redesigned automotive and operational components of the U.S. Army's Pershing 1A missile system recently completed a strenuous 2-month series of initial production tests at Aberdeen (Md.) Proving Ground.

Tests were conducted by the Materiel Test Directorate (MTD), U.S. Army Test and Evaluation Command (TECOM). The surface-to-surface missile system was subjected to simulated combat and environmental conditions in all its modes of operation to test reliability and durability.

Speed, braking, steering and water fordability qualities of the transporter were evaluated in a limited performance test. Lawrence S. Weaver, MTD senior test director, was in charge of automotive testing.

Concurrently, a team of 75 engineers and technicians, representing such agencies as the Army Missile

Command, White Sands Missile Range and the Artillery Board, performed operational and functional tests on other components.

Evaluated were improvements such as the fast-reacting erector-launcher, program/test station, control vehicle, system components test station, new family of M656 wheeled vehicles, and other second-generation ground support equipment.

The most obvious change is the conversion of the carriage system from tracks to wheels to improve speed and mobility. Pershing battalions will be able to move more rapidly in and out of preselected firing sites.

When approved for production following additional evaluation, the Pershing 1A will replace the tracked version currently deployed in a nuclear defense role in support of NATO.

The Army's Shillelagh missile system also uses many parts that are dry-film lubricated with molybdenum disulphide. Qualities of this lubricant are said to make it almost indispensable for effective continuous deployment of this sophisticated weapon shown in Figure 2.

Dr. Johnson's investigations under an Army Research Office contract already have impacted in the form of lubricants formulated to satisfy a great variety of highly exacting requirements. These returns, less than 16 years after he started his research, are regarded as remarkable in view of the normal lag of practical applications 20 to 30 years after the basic research was performed. The future offers even greater promise.

## NBS Nearing Completion Of Gaithersburg Complex

U.S. National Bureau of Standards occupation of its huge complex of 20 major buildings for its new laboratories and administrative headquarters, Gaithersburg, Md., is nearing completion except for the Fluid Mechanics Building under construction.

Three new research facilities, the Industrial Laboratory, Aggregate Processing Materials Building, and the Hazards Laboratory, are in the process of being occupied. Completion of the Fluid Mechanics Building will close out an NBS construction program that was started in 1961.

The Industrial Laboratory is concerned with technologies related to glass, ceramics, crystals, metallurgy, plastics, papers and textiles. Glass melting furnaces are available to produce special glass melts up to 20 liters. High-temperature facilities provide for preparation of polycrystalline ceramic specimens in any required shape and size.

Metal-processing equipment includes rolling mills, swaging machines, a compacting press and a variety of special purpose furnaces. A new Fourdrinier paper machine incorporates some of the most modern and highly specialized equipment.

The Aggregate Processing Building is designed for the batching, blending, processing and storage of fine and coarse aggregates used in experimental concrete programs. Standard reference materials are prepared for distribution to test laboratories throughout the United States.

The Hazards Laboratory supports two main research activities—distillation experiments and high-temperature experiments, involving chemicals having offensive or toxic vapors, fire hazards, corrosiveness and situations where explosions may occur.



SECOND GENERATION Pershing 1A missile system, converted from tracks to wheels and equipped with many state-of-the-art improvements, is destined to replace tracked version currently deployed in support of NATO forces.





Robert N. Brown



Dr. Hugh J. Barger Jr.



Andrew Cuneo



William T. Wyatt Jr.

## Mobility Equipment R&D Center Chooses 16 Employees For Commanding Officer's Special Achievement Awards

Presentation of the Twelfth Annual Commanding Officer's Awards for scientific and technological achievement and for outstanding leadership is scheduled May 23 at the U.S. Army Mobility Equipment R&D Center (MERDC).

Winners in the three categories will be selected from a field of 16 scientists, engineers and supervisory personnel at the Fort Belvoir, Va., installation. This is the largest number of nominees since inception of the awards in 1957. To encourage a large attendance of coworkers, presentation will take place at outdoor ceremonies.

The record field is due to the recent reorganization that established the Electromagnetic Effects Laboratory (formerly a division under the Electrotechnology Laboratory) and the Systems Engineering Laboratory, since each laboratory nominates candidates.

Achievements during calendar year 1968 will be reviewed by the MERDC Directorate. Each nominee will receive a Certificate of Achievement and a cash award. One winner in each category also will receive plaque-mounted medals.

**SCIENTIFIC ACHIEVEMENT** Award nominees are William T.

Wyatt Jr., Robert N. Brown, Andrew Cuneo and Dr. Hugh J. Barger Jr.

Wyatt is a physicist in the Electromagnetic Effects Laboratory. He was nominated for research involving simulated generation of the electromagnetic pulse nuclear weapon effects by high-altitude explosions. The citation credits him with advancing the state-of-the-art in this complex field.

Brown was nominated for his work as a project engineer in the Mechanical Technology Laboratory, which evolved new processes for decontamination (removal of foreign matter) of military fuels for aircraft and ground equipment. Results of his efforts, particularly the application of electrodynamic forces to achieve more effective required fuel decontamination, are expected to increase flight safety and reduce operational costs.

Cuneo is employed in the Intrusion Detection and Sensor Laboratory as a research physicist. The award nomination recognizes his contributions to the knowledge and understanding of electromagnetic wave propagation in unconventional media.

He implemented a technique for rapidly and accurately determining the electromagnetic properties of soils. This technique was used to

derive the soil electromagnetic parameters critical to design of detection equipment. Also, he applied conventional electromagnetic wave propagation theory in an unusual way to design antennas.

Dr. Barger, a research chemist in the Electrotechnology Laboratory, was named for helping to advance the state-of-the-art with respect to electrodes used in acid electrolyte fuel cells capable of operating on reformed fuels.

**TECHNOLOGICAL ACHIEVEMENT** Award nominees are Glynn E. Burchette, mechanical engineer, Electrotechnology Laboratory; Jere D. Dando, research physicist, Electromagnetic Effects Laboratory; John W. Hall, principal engineer, Engineering Laboratory; Jerry L. Wilson, mechanical engineer, Mechanical Technology Laboratory; Dr. Tibor G. Horwath, research physicist, Systems Engineering Laboratory; Hubert Comminge, mechanical engineer, Military Technology Laboratory; and Edward J. Queen, electronics engineer, Intrusion Detection and Sensor Laboratory.

Burchette was nominated for outstanding technical contributions to the design and component development work on an advanced concept 10-kw turbo-alternator electric power system.

Dando was selected for outstanding



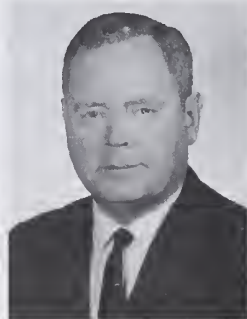
Ben L. St. Jermaine



Robert A. Jordan



Edward Prada



Nicholas P. Oglesby



William R. Clarke





Jere D. Dando



Dr. Tibor G. Horwath



Edward J. Queen



John W. Hall

technical contributions in development of methodology for nuclear electromagnetic pulse vulnerability evaluation; also, for protection of distributed ground-based systems and in applying this methodology to a critical Army weapon system.

*Hall* was chosen for his technical efforts in the design of a portable metallic and also a nonmetallic mine detector. This item is type-classified and is expected to reduce significantly the casualty rate from field mines.

*Wilson* was cited for achievements in developing a family of precise control units to maintain required environmental conditions for high-priority missile and electronic communications systems.

*Dr. Horwath* was nominated for contributions to the success of a pop-up homing mine project.

*Commings* was selected for his engineering achievement in the timely development of mine-clearing rollers to fulfill urgent requirements; also, for materially improving the Army's technical capability to cope with enemy guerrilla and mine-warfare operations, thereby conserving lives and equipment.

*Queen's* technological achievement is developing and optimizing combination logic functions. Applied to intrusion detection systems, the method has demonstrated remarkable improvements over the performance of individual detectors.

**LEADERSHIP ACHIEVEMENT**  
Award nominees are *Ben L. St. Jermaine*, chief, Equipment Modification and Repair Division, Facilities and Services Office; *Nicholas P. Oglesby*, lead element manager, FAMECE (Family of Military Engineer Construction Equipment), Mechanical Technology Laboratory; *William R. Clarke*, chief, Pictorial Support Division, Technical and Research Support Office; *Edward Prada*, chief, Test and Evaluation Branch, Electrotechnology Laboratory; and *Robert A. Jordan*, chief, Technical Data Bank.



Jerry Wilson



Glynn E. Burchette



Hubert Commings

## OCRD VE Specialist to Attend ICAF in Fall

Paul V. Dobrow, assigned to the Office of the Chief of Research and Development as HQ DA specialist for the Army Value Engineering Program, has been selected to attend the Industrial College of the Armed Forces 10-month course starting in August.

Considered the capstone of the U.S. military educational system in management of logistic resources for national security, the ICAF is a joint educational institution, operating under direction of the Joint Chiefs of Staff, at Fort Lesley J. McNair in Washington, D.C.

The ICAF conducts courses in the economic and industrial aspects of national security and in the management of resources. Consideration is given to the interrelated military, political and social factors affecting national security in the context of national and world affairs.

Studies are designed to prepare selected military officers and key civilian personnel for important command, staff and policy-making positions in the national and international security structure. Classes normally consist of 49 officers from each of the services and 33 civilians.

Dobrow was an international planner in the joint U.S.-West German Main Battle Tank Program; he was assigned to HQ U.S. Army Materiel Command as senior value engineer (1964-66) until he joined OCRD.

Graduated in 1950 with a BS degree from the Detroit Institute of Technology, he received an LLB degree from LaSalle University in 1956. He has completed the Defense Weapons System Management Course at Wright-Patterson AFB, Dayton, Ohio, two Value Engineering Courses at Rock Island, Ill., and the Navy Quality Assurance Course.

Dobrow entered Civil Service in 1951 with the Navy Department, Washington, D.C., and in 1956 became chief operations analyst, U.S. Army Air Defense Engineering Agency, Fort Meade, Md. He is a member of the Society of American Value Engineers, American Ordnance Association and the Department of Defense Value Engineering Council.



Paul V. Dobrow



# Army Defines Environmental Pollution Control Efforts in AR 11-21

Environmental pollution is defined in Army Regulation 11-21, dated Nov. 3, 1967, which provides instructions in accordance with Department of Defense directives aimed at control and abatement measures in Army areas.

Titled "Environmental Pollution Abatement," AR 11-21 states that pollution results from the presence of chemical, physical or biological agents in the air, water or soil, altering the natural environment to impact adversely on human health or comfort, or on animal or plant life structures

and equipment, to the extent of producing economic loss, impairing recreational opportunity, or marring natural beauty.

Examples of natural pollutants are ash from volcanoes, pollens and salt from waves. Man-made pollutants include blowing dust and gases from combustion and chemical processes, human and industrial wastes discharged into rivers and lakes, and contaminants from "modern" methods of farming.

Choking fogs develop in some areas

from the adhesion of water vapor on fine particles carelessly or inadvertently released into the atmosphere.

AR 11-21 prescribes a policy to control pollution and directs the Chief of Engineers to monitor the engineering aspects of environmental pollution. The Army Surgeon General is charged with monitoring the health and welfare aspects of environmental pollution control.

Standards for air pollution and for water pollution are stated which, at the time of writing, reflected those established by civilian agencies having federal responsibility for control and abatement and for determination of methods for maintaining standards.

Department of Defense (DoD) Direction 5100.50, "Environmental Pollution Control," makes the military agencies responsible and establishes a DoD Environmental Pollution Control Committee to act in an advisory capacity to the Assistant Secretary of Defense (Installations and Logistics).

The Army does not conduct research and development specifically for pollution control purposes, but does perform various types of research that can assist in development of methods of abatement activities.

AR 11-21 excludes the Civil Works Program under the jurisdiction of the Secretary of the Army and the Chief of Engineers. Responsibility of the Chief of Engineers in the Civil Works area, however, directly involves him in problems of pollution control for rivers, lakes and harbors.

As long as areas of the world were essentially rural in character, not much was said about pollution, though agricultural activities and waste disposal in open water ducts were sources of contamination.

As urban areas developed and industrial communities grew, several forms of pollution, other than those from natural sources, became common. Even in the 1920s, the electrostatic precipitation process was developed by Cottrell to restrict the escape of smoke and dust from chimneys of factories. Chemical filters were sometimes used to reduce gases, such as sulphur dioxide, belching forth from smelters. Medical considerations came under the terminology of public health.

Not until the well-publicized event in 1948 in Donora, Pa., and similar serious episodes was the public sufficiently disturbed to compel more definite efforts to restrict pollution of air.

In the Donora event, sulphur dioxide, taking on moisture from the air, formed a thick fog that was

## AMC Chief Scientists Hold Spring Meet at MERDC

U.S. Army Materiel Command chief scientists, chief engineers and technical directors discussed "MECOM Programs: Support and Interface with Other AMC Commands and Laboratories" at their spring meeting, Mar. 19-20.

The Army Mobility Equipment Research and Development Center (MERDC) of the Mobility Equipment Command (MECOM) was host to the meeting at Fort Belvoir, Va. Dr. Gordon L. Bushey, AMC deputy chief scientist, presided at the opening session in the absence of Dr. Craig M. Crenshaw, AMC chief scientist. Col Edwin T. O'Donnell, center CO, welcomed conferees.

MECOM R&D programs were discussed by Chief Engineer L. L. Gober. Technical Director William B. Taylor gave a briefing on MERDC activities, capabilities and objectives. Presentations by MERDC personnel included "Electromagnetic Pulse Effects on Army Materiel," "Metal Detection Radar," "Fuels Decontamination R&D," and "Materials Research."

Representatives of various AMC subcommands reported on related

activities, including some of the significant progress and problem areas.

Principals at the meeting also included W. H. Brabson Jr., director of R&D, U.S. Army Aviation Systems Command (AVSCOM); Dr. H. K. Ziegler, chief scientist, Electronics Command (ECOM); Dr. J. P. Hallows Jr., chief scientist, Missile Command (MICOM); R. M. Schwartz, chief engineer, Munitions Command (MUCOM); B. S. Goodwin, special assistant, Test and Evaluation Command (TECOM); Dr. Colin M. Hudson, chief scientist, WECOM; Dr. Dale H. Sieling, scientific director, Natick Laboratories; and

Col Eduardo M. Soler, CO of AVLABS (Army Aviation Laboratories); Dr. C. F. Pickett, science director, Coating and Chemical Laboratory; Billy M. Horton, technical director, Harry Diamond Laboratories; Dr. J. D. Weisz, technical director, Human Engineering Laboratory; Lt Col J. E. Wagner, codirector, Terrestrial Sciences Center; and Dr. Eraldus Scala, technical director, Army Materials and Mechanics Research Center.



PRINCIPALS at AMC meeting of chief scientists, engineers and technical directors included (from left) Dr. Gordon L. Bushey, AMC deputy chief scientist; William B. Taylor, technical director, Mobility Equipment R&D Center, Fort Belvoir, Va.; Col Edwin T. O'Donnell, MERDC commander; L. L. Gober, chief engineer of the Army Mobility Equipment Command, St. Louis, Mo.



unable to escape upward through a heavy inversion in the atmosphere. Many people were made ill and some died.

In the Air Quality Act of 1967, colloquially known as the Clean Air Act, the Department of Health, Education and Welfare (HEW) was made responsible for establishing standards and methods of controlling air pollution. Not only soot, dust and carbon dioxide, which represent common pollutants, but more recently, radioactive particles and metals, such as beryllium, are pollutants requiring expensive methods of monitoring control and abatement.

In the design of buildings and military structures, in planning for disposal of waste, and in protecting military personnel from exposure to noxious materials, it is necessary to consider what, how much, where, and the method of travel—in air or in fluids.

About 1967, the responsibility for the control of pollution in water was transferred from HEW to the Department of the Interior, which is closely associated with the establishment of recreational areas and beautification.

Thermal pollution by hot fluids from industrial and atomic power plants, flowing into bodies of water, is

now a serious consideration. More recently, the repeated incidents of pollution of beaches by oil from leaking ships or oil wells has led to the submission of Senate Bill S-544, A Water Quality Improvement Act of 1969.

The Senate Subcommittee on Air and Water Pollution is considering this bill, which calls for establishment of standards, methods and restrictions aimed at reducing pollution in the waters in and around the country.

## CE Chief Geologist Retires With 35 Years Civil Service

Robert H. Nesbitt, an internationally known engineering geologist employed by the U.S. Army Corps of Engineers, retired at the end of February after 35 years of U.S. Government service. Nesbitt had been chief, Geology Branch, Engineering Division, Directorate of Civil Works, Office of the Chief of Engineers, and chief geologist for the U.S. Army Corps of Engineers for the past 12 years. He was assistant chief geologist for the preceding 9 years.

As chief of the Geology Branch, Nesbitt was chief technical adviser in the field of engineering geology on the design and the construction of all flood-control, navigation, and hydro-power structures of the Corps of Engineers as well as other projects, and was responsible for the planning and the over-all supervision of engineering geology and rock mechanics research in three of the Corps of Engineers' laboratories.

More than 100 dams, ranging from 50 to 450 feet in height, were constructed by the Corps of Engineers during his period of service.

## \$271,000 Provides for Study Of MBT-70 Support Equipment

Studies to aid evaluation of vehicles that will support the U.S./Federal Republic of Germany Main Battle Tank being developed for the 1970s were initiated recently by award of a \$271,000 contract.

The U.S. Army Tank-Automotive Command (TACOM) announced that the Lockheed Missiles and Space Co. will provide data to the Army representatives who will evaluate the support equipment that will accompany the MBT-70s.

Among the possible support equipment under study are an armored recovery vehicle to aid damaged tanks, a combat engineer vehicle equipped with a boom, winch, bulldozer blade and demolition gun, and an armored-vehicle-launched bridge. The bridge will enable the MBT to cross 60- to 100-foot streams and gullies.

Computer studies will be linked to simulated combat conditions for each of these vehicles as anticipated in the time frame of the 1970s. The high-speed electronic battles will feed data into the computer for evaluation in theoretical and engineering designs. Ellis B. Kuhns is project leader of the 14-man study team.

"The MBT can move faster than any other current tracked Army vehicle," he explained. "Its suspension, firepower—in fact, everything about it, represents a big advance over other tracked vehicles. For an efficient system, its companion vehicles must have matching capabilities."

Current operational tank companion vehicles are included in the studies, including those supporting the M-60. Cost-analysis factors will be considered with respect to the most desirable combination of high-speed mobility, durability, reliability and survivability.

## Aviation-75 Study by CDC Foresees Airmobile Army

Introduction of the AH-56 Cheyenne attack helicopter into the inventory is among dramatic developments foreseen in an 18-month study of aviation needs for the Army of 1970-75.

The Aviation-75 Basic Derivative Study by the Army Combat Developments Command (CDC) Aviation Agency, Fort Rucker, Ala., was aimed to define operations, organizations and materiel required to support the combat arms.

Included were doctrinal changes for aviation units and the numbers and types of aircraft that will be needed. Greater use of the heavylift helicopter for carrying larger payloads was considered among other airframe, avionic and associated equipment.

## HumRRO Names Dr. Lange Assistant VP for Research

Dr. Carl J. Lange, assistant director for planning at the Human Resources Research Office (HumRRO), a U.S. Army contract agency, was named assistant vice president for research at George Washington University in March.

Dr. Lange's responsibilities will include direction of the Office of Sponsored Research and the Educational Resources Information Center Clearinghouse on Higher Education. He joined HumRRO in 1953, two years after it was established, to conduct research and scientific studies and evaluations within the scope of the DA Human Resources Research Program.

Dr. Lange has a BS degree from Duke University (1945), and received MS and PhD degrees in psychology at the University of Pittsburgh (1948, 1951). He served in the U.S. Navy during World War II.

He was Work Unit leader on OFFTRAIN, the HumRRO project which provided research data for the leadership training program now being used in all Army college ROTC programs. Until he was appointed a HumRRO assistant director in 1964, he was director of research at HumRRO Division No. 4 (Infantry) at Fort Benning, Ga.

In 1966-67, he was interim executive director, Central Atlantic Regional Educational Laboratory (on loan from HumRRO), and earlier in his career he was project leader for the American Institute for Research. He also has worked as a senior psychologist for the U.S. Government and University of Pittsburgh research assistant.

Dr. Lange is a Fellow of the American Psychological Association, and a member of Sigma Xi, science honorary. He also holds membership in the American Educational Research Association, the Southern Society for Philosophy and Psychology, the American Academy of Political and Social Science, the Futurist Society, and the District of Columbia Psychological Association.



Dr. Carl J. Lange



## DCRD Coffin Leaves to Command SETAF

Deputy Chief of Research and Development Maj Gen Robert E. Coffin left that position Mar. 27 for assignment as commanding general of the Southern European Task Force (SETAF), headquartered in Vicenza, Italy.

Brig Gen Kenneth F. Dawalt, Dep-

### ARO-D Focusing on Data At 8th Symposium on OR

Programing for the Eighth Army Operations Research Symposium, May 21-23, at the Army Research Office-Durham, N.C. is focused on "Data Collection and Analysis for Operations Research."

Except for those chosen to present technical papers, attendance will be limited to selected representatives, on a quota basis, from each of the major Army commands and staff elements at HQ Department of the Army. About 190 participants are expected.

Seven consecutive sessions will be directed to different facets of the role of data collection and analysis in planning, programing and conducting operations research.

Dr. Daniel Willard, research analyst, Office of the Under Secretary of the Army, and Col Russell McGovern, chief, Studies and Analysis Division, U.S. Army Research Office, will present the symposium summary and critique.

Acceptance of an invitation to a senior official of the Department of the Army to present the opening address had not been confirmed as the *Army R&D Newsmagazine* went to press. Dr. John Honig, chief, Weapons Systems Methodology and Concepts Office, Office of the Assistant Vice Chief of Staff, HQ DA, is programmed for one of the main addresses.

A senior representative of management in industry will be invited to make the principal address at the banquet. The symposium is attended by invited high-ranking industrial leaders interested in reports of progress in developing operations research techniques.

uty CRD for International Programs since June 1966, will be acting DCRD.

General Coffin had served as DCRD since Sept. 15, 1967, following more than two years as chief of the Nuclear Activities Branch, Supreme Allied Powers, Europe (SHAPE). In 1955 he had served as chief of the OCRD Atomic Division and later as chief, Missiles and Space Division.

Ten years ago General Coffin served at HQ SETAF as G-3 and in 1960 was assigned as commander, 1st U.S. Army Missile Command in Italy. He was chief, Plans, Operations Division, HQ U.S. Army Europe and then assistant chief, Operations, HQ USA-REUR, Heidelberg, Germany, from 1961 to 1963. His next assignment (1963-65) was assistant commander, 2d Infantry Div., Fort Benning, Ga.

General Coffin began his military career as a second lieutenant in the 3d Infantry Division following gradu-



Maj Gen Robert E. Coffin

ation from Stanford University in 1939. He served in North Africa and in the European Theater of Operations during World War II. He is a graduate from the Command and General Staff College, Armed Forces Staff College, and the National War College.

## OCRD Announces 3 New Personnel Assignments

Personnel turnover in the Office of the Chief of Research and Development (OCRD), HQ DA, reached one of the low points for the past year when only three newcomers reported for duty since the report of changes in the March edition of the *Army Research and Development Newsmagazine*.

Lt Col William D. Guinn Jr. is serving as assistant executive for Administration, OCRD, following a tour of duty as battalion commander with the American Division and adviser, Quang Ngai Sector, Vietnam.

In 1952 he graduated from the University of Tennessee with a BS degree in business administration. He earned an MBA degree from the University of Alabama in 1967 after completing the residence course at the Command and General Staff College (C&GSC).

Lt Col Guinn served with the V Corps in Germany from 1962 to 1964. Since entering active duty in 1952, he has been awarded the Silver Star (SS) with Oak Leaf Cluster (OLC),

Legion of Merit, Bronze Star Medal (BSM) with OLC, Air Medal (AM) with 21 OLC, Army Commendation Medal with two OLC, and the Purple Heart with three OLC.

Lt Col Warren C. Stone, assigned to the Programs and Budget Division, was comptroller, Field Operations Division, U.S. Arms Control and Disarmament Agency in Washington, D.C., from July 1967 until March 1969.

He competed a tour of Vietnam with the 1st Logistical Command (1966-67) following completion of the C&GSC (1965) and assignments as an instructor, then director of Academic Operations at the U.S. Army Finance School, Fort Benjamin Harrison, Indianapolis, Ind. (1962-64). He served as a finance and accounting officer at Nuremberg, Germany (1958-61).

Lt Col Stone received a BS degree in military science from the University of Maryland in 1961 and in 1966 earned an MBA degree from Syracuse University. His decorations include the Legion of Merit, Purple Heart and Army Commendation Medal.

CW4 Joe C. Garner returned for his second assignment as an administrative officer, OCRD, following a tour of duty in Vietnam. He served in this capacity in OCRD from 1961 to 1968.

Garner was administrative officer, Engineer Section, HQ Seventh Army, U.S. Army Europe (1957-61), personnel officer, HQ U.S. Military District of Washington, Fort Myer, Va. (1955-57), and administrative officer, HQ KMAC, Korea (1954-55).



Lt Col W. D. Guinn Jr. Lt Col Warren C. Stone CW4 Joe C. Garner



# WECOM Adopts Microfilm System for Retrieval of Industrial Catalog Data

Management Science Office personnel at HQ U.S. Army Weapons Command are microfilming industrial catalogs to achieve greatly improved utilization with important cost and time savings.

Microfilming catalogs containing up to 200 pages or more might appear quite a task—particularly when more than 2,800 catalogs eventually are expected to be involved in the system. But the process is proving relatively simple. As of mid-March, about 25 catalogs had been put into microfilm form.

Advantages of the system are numerous with respect to the problem of storage of information in the form best suited to rapid retrieval for use. A WECOM Management Science Office employee cited the case of a man working on the development of a weapon system, stating:

"The particular phase he was concerned with might call for relays and microswitches. Naturally, it would cut development time if they were already available. The researcher would go first to the federal catalogs listing Military Standard equipment. Then he would search the electronic gear on the Qualified Products List.

"If he could not find the needed items on either list, he would have to ask manufacturers of electronic gear for their catalogs. As a result, he probably would end up with a fair but not complete compilation of the electronic products available.

"But, and this is where the real rub came in, the exact things for which he was searching might be in some manufacturer's catalog he had failed to obtain. Still, someone else in HQ WECOM, working on another problem, might have that catalog. There was no guarantee the two users could get together, or that the combined sets of catalogs would list pre-

cisely what either man was seeking."

Moreover, sometimes an action officer just could not, in consideration of the urgency of his requirement, wait on a manufacturer to supply a catalog that might have simplified the job.

WECOM's Management Science Office thus was confronted with the task of achieving order for efficient use of a conglomerate of catalogs, indexes and files.

To get the program started, a commercial microfilmed catalog filing system was purchased. But that was just the beginning. Requirements expanded beyond the capacity of the commercial system, and some extra benefits have been added.

For example, the original list started with approximately 200 catalogs containing thousands of items such as switches, bearings, wires, relays, valves, diodes, welding products, ladders, pipe-bending machinery, pumps, optics, bushings, electrical tools, gears, ultrasonic devices, die sets, compressors, fasteners, seal rings, chemicals, automotive products, calculating machines, grinding and polishing devices, semi-conductors, instrumentation and control devices, machine tools, jacks, plastics, ceramics, adhesives, metals, paints, rust preventatives, servomechanisms, straps, hand tools, rubber products, drills and timing instruments.

The current list includes about 2,800 catalogs and is being expanded.

In the interest of rapid retrieval of desired information, each of the organizations within WECOM has its set of microfilmed catalogs. In roughly the same space that a normal filing cabinet would occupy, a microfilm "reader" and a set of microfilmed copies equivalent to 25 catalogs has been provided.

Eventually, a closed-circuit television network will connect each of the readers with the central repository of catalogs. Then, any of the 2,800 catalogs will be available to any member of WECOM who has a need for them. Storage capacity at each of the reader stations presently is limited to the catalogs used most frequently by members of that WECOM organization.

The storage capacity at each of the 10 stations now in operation is estimated as equivalent to that of 25 filing cabinets. At normal rental rates of \$3 to \$9 per square foot per year, the estimated annual saving in floor space requirements at each station is the equivalent of \$5,700 to \$17,100. The 250 file cabinets that would otherwise be used can be diverted to other uses, or simply not be purchased in the first place.

The most important benefit is the intangible one of knowing that efficient system of access to knowledge about commercial products that may contribute to achievement of continuing technical excellence in weaponry is being used by U.S. Army Weapons Command.

## Boaz Heads Preventive Medicine Division, OTSG

Col Thurmond D. Boaz Jr. was assigned recently as chief, Preventive Medicine Division, Directorate of Professional Service, Office of The Surgeon General (OTSG), Washington, D.C. He has headed the Environmental Medicine Branch, Preventive Medicine Division, OTSG, for the past 3½ years.

Formerly chief of the Special Projects Branch, Life Sciences Division, Office of the Chief of Research and Development (1963-65), he succeeded Col Herschel E. Griffin, who retired from military service to become dean of the Graduate School of Public Health, University of Pittsburgh.

Col Boaz earned a BS degree (1934) and MD degree (1939) at Louisiana State University. His master of public health degree (1950) was earned at the Harvard University School of Public Health. In 1961, he was awarded the "A" Prefix for outstanding contributions to military preventive medicine.

He is a Fellow of the American Public Health Association and a charter member of the American Association of Public Health Physicians and the American College of Preventive Medicine. He also is a member of the American Medical Association, the American Association for the History of Medicine, and the Association of Military Surgeons of the United States.



Col Thurmond D. Boaz Jr.



Clerk Typist Karen Buckmeyer demonstrates microfilm reader used in industrial catalog data retrieval system at U.S. Army Weapons Command.



# Campus Turbulence Tears at Traditions

*Change and innovation* are key words in research and development.

Widespread student revolts and faculty rebellions are violently evidencing demands for dramatic developments in administrative policies and the curriculums in the nation's educational institutions. Traditionally honored social values, relationships and moral principles are assailed as unrealistic and outmoded.

In discussing "The Process of Effecting Change" in the Presidential Address to the Division of Military Psychology, American Psychological Association in September 1968, Dr. William A. McClelland, Human Resources Research Office (HumRRO), presented a challenging thought-provoking message. HumRRO is an element of The George Washington University and since 1951 has operated as an Army contract agency.

*Although his address was in no way intended to relate to the current turbulence on the college campuses, the foment serves to redirect attention to many of the points he made. Dr. McClelland has been associate director of HumRRO for five years and has been involved in military psychology R&D activities for 20 years.*

Graduated as a Phi Beta Kappa from Brown University, he has MA and PhD degrees from the University of Minnesota, and was a university administrator and Air Force research psychologist until he joined HumRRO in 1955.

In the summary of his APA address, he explains his purposes as follows:

*"In this paper, I have attempted to indicate the importance of our understanding of the process of change; also, to summarize some of the relevant literature on the diffusion of innovations, drawing from studies in rural sociology, cultural anthropology, industrial settings, education and psychology."*

The condensation of his presentation (39 pages, four of references) follows.

## The Process of Effecting Change

*"Most of the change we think we see in life is due to truths being in and out of favor."—Robert Frost.*

*"It is true that what is settled by custom though it be not good yet at least it is fit. And those things which have long gone together are as it were confederate with themselves; whereas new things though they help by their utility, yet they trouble by their in-conformity. Besides they are like strangers, more admired and less favored."—Sir Francis Bacon.*

The truth of Bacon's prose is apparent to us all, that is, to all of us who are concerned about the utilization of our research results.

In selecting my topic I felt I was applying at least in part Dick Trumbull's concept of relevance so eloquently elaborated in his Presidential Address to this Division two years ago. The military departments, Trumbull stated, have a "need to know which includes every facet of human existence and performance both at home and in other cultures."

It is my contention that not only

have we as psychologists a need to know the facts about the human condition, but we have also a great need to know how to use this information to improve human effectiveness.

Not all of the psychologists in Division 19 are or should be concerned with applications. Yet the current emphasis in federal government R&D programs is very strong upon demonstrations of the utility of our science today. Many of us are strongly encouraged to undertake research and studies that will make a difference in the real world, the kind of research which will make a difference relatively soon in how we go about solving problems in education in our cities, in the environment in which we live and in the defense of our country. Some of us at least must be concerned with the process of effecting change.

*Will the findings of research be put to use? Will knowledge be utilized? The historical record is not a bright one.*

My time with HumRRO is especially relevant, since HumRRO has always been oriented toward the



Dr. W. A. McClelland

conduct of R&D which would contribute the solution of an Army training or operational problem. We have been concerned with utilization and perhaps even more concerned when utilization has not occurred. We live with and are concerned with the process of effecting change, primarily as a practical strategy.

The U.S. Department of Agriculture, the U.S. Office of Education, the Agency for International Development, the Defense Department, the State Department, state and local government departments and agencies, private foundations and multitudinous facets of business and industry are all very much interested in the process of change. Why, the word "innovation" enjoys as great popularity today as did the word "systems" 10 years ago!

But what do we know about change? Why are some innovations adopted while others are not? How does one really move from research to development to application and use? What accounts for the differential successes of individual change agents and applied R&D organizations? How can an innovation, once implanted, be sustained?

*Background.* Cultural anthropologists have been interested in the change process for perhaps longer than any other discipline. A few educators were examining the rates of diffusion of new ideas 30 years ago. Rural sociologists, who have had a continuing interest in innovation research since the 1920s, pioneered in the quantitative study of the diffusion process.

Since World War II, a variety of people working in industry (economists, historians, engineers, and psychologists) have actively pursued studies in the area. In recent years, there has been a growing number of case studies from which testable hypotheses are emerging.

Before the 1950s, there was little or no convergence of the approaches undertaken by the disparate formal disciplines. Today no conference or volume of essays on innovation is quite complete without cross-disciplinary representation.

While the individual scientists and practitioners may not yet speak each other's language with confidence or use one another's concepts freely, diffusion researchers seem to understand one another. The literature has grown from the mere handful of studies completed prior to 1940 to over 1,100 by 1967.

A final background note may add perspective. Studies of adoption rates may provide a normative note of cheer to military psychologists con-



cerned with utilization of research and development. In education the classic studies of Mort and Cornell, published in 1941, indicated that it took about 50 years for complete diffusion of such practical inventions as the kindergarten to take place. More than 15 years elapsed before 3 percent of the nation's schools adopted change.

In agriculture, individual farmers took about 15 years to adopt a new hybrid corn. Findings from Project HINDSIGHT and an Air Force Office of Scientific Research study suggest that a 5- to 10-year period is typical of the lag in the use of a scientific or technological finding or event.

While HumRRO experience with Army utilization of R&D has not been studied formally, the range of time from completion of research to implementation of resulting product or use of the information has ranged from a few weeks to over 10 years.

*What do we know about change?* What can psychology, especially those psychologists engaged in R&D for the Defense Department, learn from change studies conducted by anthropologists, educators, engineers, and sociologists? At a minimum we may find some of the concepts, tools, and procedures worthy of further study, test and application.

*Types of change.* Students of the change process speak of three types of change: imitation, selective contact change and directed contact change. My concern, however, is with directed contact change or planned change, that is, a deliberate and collaborative process involving an agent of change and a client system. Change can come solely from within the system, but the contemporary national and international scene is clearly preoccupied with directed or planned change.

Our knowledge of planned change is a blend of experience and intuition, with a large dash of folklore, to which there is slowly being added a body of scientific literature. Most diffusion research is not hard science; it clearly belongs in the domain of social science. For innovation of any kind is a social-behavioral phenomenon.

*Elements in a Diffusion of Innovation.* E. M. Rogers in "Diffusion of Innovation" (1962) has identified four key elements in diffusion which bear scrutiny, namely the innovation itself, communication, the social system and time. A brief look at each may help to provide structure for understanding the process of effecting change.

The nature of the innovation will be discussed more fully in the next section (on "Factors Inhibiting or Accelerating Change"). Communication is defined by Rogers as the transfer of ideas from source to re-

ceiver. Some innovations are more visible than others and therefore diffuse more rapidly. For example, which rat poison will diffuse more rapidly, one which kills rats in their holes or one with the same lethality which kills them in the open?

A third key element in diffusion is the social system, that is, a "group of individuals (or units) who are functionally differentiated and engaged in collective problem solving around a common goal or output." (Translation for military psychologists: A submarine or an air defense crew, an infantry squad, a station hospital or the staff of a weapon system project office are all examples of social systems.)

As all good students of social psychology or engineering psychology are well aware (and sometimes *painfully* aware), each social system may have a different set of norms and different role expectations of its members. The members of the system individually and/or collectively make decisions to accept or reject a given innovation. All too frequently, we are much better able to lay out an efficient work station for a new communications system than we are able to convince the project engineer of its obvious merits.

Time is the fourth key element. It takes time for the client to travel the majestic route from awareness of the innovation, to the arousal of interest,

to an evaluation of the idea, through an actual trial to arrive finally at adoption or rejection. In terms which are perhaps more comfortable to psychologists, the decision process involves acquisition of knowledge, attitude formation and change, the rendering of a decision, and data gathering to confirm it.

*Factors Inhibiting or Accelerating Change.* Much has been written on the factors that inhibit (or accelerate) change, and the work is very uneven in quality. It extends from speculation based on experience through empirical studies to controlled experimentation.

The contexts studied range from villagers in agrarian societies to retail drug -salesmen, from Iowa farmers to school administrators, from business managers to Defense Department managers, and from individuals to organizations.

Generalizations from such a diverse literature can therefore be characterized only as suggestive or, more generously, as the raw materials for the formation of hypotheses for test.

*A General Perspective.* One widely quoted set of characteristics of innovations which affect the rate of adoption has been offered by E. M. Rogers, as follows:

- *Relative advantage*, that is the  
(Continued on page 20)



Two of Harry Diamond Laboratories' 20 Army ROTC officers with advanced degrees, Capt Jerry Calkins and Lt David Egolf, recently gave a presentation of fluidics to the Science-Electronics Club of Jefferson High School, Arlington, Va. The speakers demonstrated the Army artificial implantable heart (which Capt Calkins is holding), the latest Army blood pump (center of table), the Army emergency respirator (held by clamp on which Calkin's hand is resting), and a model of the Pulse-Duration Modulation System which demonstrates attitude control of a rocket by a fluidic system (contained in the black case at right of the table). Arranged and scheduled by the HDL Public Information Office as a commitment under its Speakers Bureau Community Affairs Program, the event gave the young scientists an opportunity to view equipment that uses fluid amplification. (See Army R&D Newsmagazine, March 1967, p. 23).



# The Process of Effecting Change

(Continued from page 19)

degree to which an innovation is perceived as better than that which it supersedes. Relative advantage can be expressed in such terms as economics, prestige or convenience to the client.

- **Compatibility** or the degree to which an innovation is consistent with the existing values and past experiences of the client.

- **Divisibility** is psychologically somewhat similar to buying on the installment plan. It is the degree to which an innovation may be adopted on a limited basis. For training or educational researchers, for example, a divisible innovation could be adopted by part of a school system. In contrast to a stage-by-stage adoption, an all-or-none adoption would not have the characteristics of divisibility.

- **Complexity** or the degree to which an innovation is relatively difficult to understand and use. The resistance that school teachers manifested some years ago toward the use of motion picture projectors may be a simple example of too great complexity.

**Analysis of Cultural Factors.** A. H. Niehoff, a cultural anthropologist who has analyzed a carefully selected sample of several hundred case histories of cross-cultural change projects in agrarian societies, offers a much more specific listing (HumRRO technical report on "Cross-Cultural Innovations in Agrarian Countries").

His analysis of these case studies has yielded a sizable number of hypotheses concerning ways in which characteristics and behaviors of change agents and characteristics of recipients operate to influence the success or failure of innovative efforts. He hypothesizes that transfer of an innovation is easiest, most likely to be successful, if:

- Innovations are selected that tend to be compatible with the cultural patterns of the recipient group. This means that the amount of new behavior which must be accepted and the amount of old behavior which must be given up will be minimal.

- Innovations are selected that will meet existing or felt needs of the recipients, preferably those which they have tried to solve through their own efforts.

- Innovations are selected that will provide practical benefits in this world as perceived by the recipients, usually by improving their economic position.

- The strategy of introduction will involve adapting to and working through the local cultural patterns, particularly the pattern of local leadership.

- Channels of communication are established by the change agent which provide an efficient 2-way flow of information. Especially vital will be feedback channels from the recipients to the change agent.

- The recipients are involved in the introduction process through full participation. Of most significance will be their contribution of planning, material goods, time or labor.

- The change agent is flexible in his strategies, altering them to meet unforeseen circumstances.

- The change agent establishes patterns of maintenance among the recipients so that the innovations can be continued when his influence is withdrawn.

**Problems in Educational Change.** What is the situation in the field of education? R. Schmuck somewhat cynically provides a large clue (in his 1966 Presidential Address to the DMP, APA, "Social Psychological Factors in Knowledge Limitation as Applied to Educational Administration"):

"The lack of knowledge utilization is truly social psychological in the sense that it involves both parties simultaneously interlocked in a complex set of ineffective communications."

An equally general and valid observation is offered by S. C. Rankin and V. E. Blanke (in an April 1965 Ohio State University newsletter article, "REL's: Are They Here to Stay?").

"Two assumptions reoccur frequently in the literature on educational change: (1) there is a large gap between theory and practice, and (2) special organizations must be created and individuals trained to bridge this gap if educational improvement is to be consistent, effective and efficient."

Although there is a wide range of opinions as to why this situation prevails, educators and scientists who have studied school systems would probably agree that the following factors inhibit diffusion.

- The diffuseness of the goals of education. The goals of education are multiple, especially those having to do with socialization of the students. Rare indeed are good instructional objectives stated in terms of the behavior which is to be attained through the educational process.

- Lack of an established "engineering function" in the educational system. Teacher education programs do not develop the needed skills and knowledge to engineer innovations nor have teachers developed the necessary habits of scholarship.

- Lack of evaluation and feedback. This follows quite naturally from a lack of precise goals. How can the effects of an innovation possibly be assessed if it is unclear as to what objective the change is relevant?

- Attitudes of reticence, suspicion and fear on the part of educators. The school system is highly vulner-

## CDC Assigns Halloran as Comptroller/Program Coordinator

The U.S. Army Combat Developments Command (CDC), Fort Belvoir, Va., recently announced that Col Joseph E. Halloran Jr. is reassigned as Comptroller/Program Coordinator after serving as Deputy Comptroller/Director of Data Processing and Programs.

Col Halloran, 48, entered the Army as an enlisted man and was commissioned in the Armor Branch after graduating from Officer Candidate School in September 1943.

His new duties make him responsible for formulation of policies and coordination of functions relating to budgeting accounting, progress and statistical reporting and analysis, internal control systems, management of CDC program coordination, and organization systems analysis.

He has a BS degree in civil engineering from the University of Arizona in Tucson and earned an MS degree in business administration at Syracuse University, New York. His civilian experience includes work as a design engineer and a construction superintendent.

In 1962, he completed a tour of duty in the Republic of Vietnam with the Advanced Research Project Agency. Other overseas duties have taken him to England, Japan and Turkey. He has served as a research engineer, Transportation Research and Development Command, Fort Eustis, Va.; staff exchange officer, Royal Engineers Transportation Center, Camp Longmoor, England, and as deputy comptroller, Fort Leonard Wood, Mo.



Col Joseph E. Halloran Jr.



able to a great variety of powerful influences in its environment such as parents, school boards and power elites in the community. The situation breeds conservatism, and the reticence of the school administrator in advocating change is not surprising. Even his colleagues and staff may resist. Such a state is not conducive to full communication and a creative working relationship designed to produce change. Further, the innovation may not be compatible with the existing values and past experience.

- Management problems and funding problems. Both of these factors inhibit the diffusion of innovation. An innovation that is complex and not divisible is much more likely to be costly than one that is simple and divisible. And how does an administrator manage individualized instruction with a quasi-professional staff? Finally, the educational bureaucracy itself is a source of resistance to change.

Surveying the above listing, one might feel very pessimistic about change in education. Yet according to the architects of planned educational change, the sources of resistance are amenable to study and to modification, but the data clearly suggest reducing their effects will take time.

**Levels of Change.** R. Chin, in "Models and Ideas About Changing" (1964) in *Media and Educational Innovation*, University of Nebraska Press, has drawn a useful distinction among levels of change which could also be viewed as differing definitions of change. He has identified five such levels which appear to occupy different points on a continuum of amount or degree of changing the structure of the client system. This concept of level of change is definitely related to the factors inhibiting innovations, since the scale seems to range from the easiest to the hardest to accomplish.

- *Substitution* of one insulated segment for another is the first and simplest form of change. For example, adoption of a new work book for the same text is likely to have little or no additional system effects.

- *Alteration* may involve a minor change but one which can have unforeseen systemic effects. For example, what if the new work book requires additional laboratory space and equipment with which the teacher is unfamiliar?

- Sometimes a third level of change occurs, namely, *perturbations and variations* in the client system. Temporary oscillations do occur, but they represent variations in the equilibrium of a system.

- *Restructuring* is the fourth level of change, and it represents funda-

mental change in the structure of the system. Chin states, "Change of this order is basic social change." The adoption of a new elementary school mathematics curriculum is a familiar example.

- Finally, and most complex of all, is *value orientation* change. The contemporary wisdom of the observations DeTocqueville made about American society more than 100 years ago suggests how slow is the change in our national character.

It should be quite obvious, then, that there are very likely to be different principles of change, as a function of the level of change involved. Strategies of change must incorporate such considerations.

**Characteristics of Innovators.** In planning change, it may be helpful to know something about the characteristics of people who have been innovators. The literature contains descriptions of successful innovators from many different contexts and disciplines. Are there some commonalities? If so, they may be helpful in the selection of strategies for effecting change.

- The cosmopolite versus the localite. First, there is an interesting application on the old adage that "travel broadens." Dissemination seems to be facilitated when the innovators get around, particularly outside their normal environments. . . . Anecdotal HumRRO data include several instances in which the U.S. Marine Corps, the Israeli Army, the Canadian Army and the Norwegian

Air Force adopted HumRRO findings before the United States Army did.

- Age. The data are equally good (or bad) on the role of the age of the innovator. Farmers and physicians [adopting innovations] tended to be younger. Similarly, younger professors were found to be more receptive to educational television. Educators suspect that it is the younger teacher who is more receptive to innovation.

- Position in and attitude toward communication networks. Mention has already been made of the multidimensional flow of interactions among research, development and use activities. Those who move freely among these activities seem to be among the more successful innovators. . . . Richard's study of a traveling seminar modeled somewhat after the Agricultural Extension Service implies educational innovators are more completely involved in a variety of communication networks. This characteristic of innovators is probably related to the cosmopolite factor.

- Personal or organizational affluence. Individual earlier adopters seem to be more affluent than late adopters. For example, they plant more corn acreage, have more income or have richer patients. The two measurable (and hopefully manipulable) educational innovative attributes were high teacher salaries and high school density.

A healthy bureaucratic organization (such as a large private company, a federal agency, a military service or an R&D laboratory) is, R. G. Havelock notes, a *very promising* (his italics) target for the practitioner of planned change. One of the rationales for the Elementary and Secondary Education Act was to fund a new complex of educational organizations, a concept at least in part stimulated by the signal success of the Agricultural Extension Service, previously the only government activity of its kind.

- Personal attributes and characteristics. There is just about no generalizable and reliable data on the personal attributes of successful innovators, but this should surprise no one. . . . Some of the personality descriptions in the literature suggest the innovator is not the most comfortable person to have around, but then sensitivity training specialists report they have answers to this and other aspects of obstinacy in resisting change.

*What kinds of leverage can the change agent bring to bear in terms of his assumptions concerning the nature of the client?*

E. G. Guba has provided a simple taxonomy which should have consider-

(Continued on page 22)



AUSTRALIA'S first program manager of the 4-nation Mallard Project, Lt Col Lisle G. Moore (left), welcomes Lt Col David J. McMillen as his successor in the cooperative development of a tactical communications system by the United States, United Kingdom, Canada and Australia. Other high-ranking Mallard officials are Maj Gen Paul A. Feyereisen, program-project manager for the U.S.; Lt Col Douglas C. Coughtry, program manager for Canada; Brigadier Harry Roper, manager for U.K.



# The Process of Effecting Change

(Continued from page 21)

able pragmatic value ("Diffusion of Innovations," *Educational Leadership*, January 1964). He opines that the client may be viewed as having one or more of the following characteristics:

- He is rational. He can be convinced by data, by rational, empirical, logical evidence. The logic of the change proposal will lead him to adopt it. Historically, the military psychologist has leaned very heavily on the use of data. He would rarely advocate change unless he himself was convinced by the evidence. We have implicitly assumed that since we are rational beings, so is the client. Stated this way, our experience suggests the assumption is a bit naive, or at best only a partial truth.

- He is untrained. Therefore, the client must be taught how to perform in relation to the innovation. The didactic approach requires the use of workshops and in-service training, an approach the military services have used extensively.

- He is a psychological entity who can be persuaded.

- He is an economic entity who can either be compensated or deprived. The federal government provides an excellent example of the use of financial rewards (and punishments) through a multiplicity of programs to assist educational institutions and other segments of the national community to move in desired directions.

- He is a political entity who can be influenced. No one working for government . . . or in industry . . . or in education at any level can fail to have been exposed to examples. Enough said.

- He is a member of a bureaucracy who can be compelled. Pulling this lever, however, does not normally produce a high yield.

- He is a member of a profession who can be professionally obligated.

*Strategies of Change.* We come now to the matter which concerns all technologists, namely, how you get things done. What strategies are available for effecting change and how useful are they? The first question is relatively easy to answer by reference to the literature on diffusion research. The second is largely unanswerable because the circumstances of use are so many and data are so scarce. Still, guidelines have heuristic value and may, subsequent to refinement, be fit subjects for more rigorous test.

There are, in the literature, several general conceptualizations of change strategies, plus some specific ones. Chin proposes the following three general categories of approaches:

a. Empirical-rational approaches in which "the primary task is seen as one demonstrating through the best known method the validity of the new mode (the proposed change) in terms of the increased benefits to be gained from adopting it."

Examples from the area of applied research can easily be found in the research-development-use cycle of most government-sponsored research groups. The innovation is developed, information about it is disseminated, it is adopted (frequently after trial) and finally it is installed and institutionalized.

b. Normative-reeducative approaches, a second category, are usually based on some theory of change as applied to individual behavior in small groups, organizations and communities. Strongly influenced by Freud, Dewey and Lewin, this family of change strategies concentrates on the pivotal role of values, on a *people* not a *thing* technology.

Emphasis is placed on the way the client views himself and his problems. The change problem is not the absence of information; it is one of attitudes and values. Change agency and client or client system interact, each learning from the other while they examine the concepts of motivation, morale and productivity.

One example from many might be sensitivity training. The source of influence, the nature of the leverage to change, is "in the psychological processes of identification with the change agency and of internalization of the 'ideal' mode of behaving," supported, of course, by group norms operating

in face-to-face contexts.

c. Power approaches, Chin's third category, are used to "alter conditions within which other people act by limiting alternatives or by shaping the consequences of their acts or by directly influencing and controlling actions." Compliance and submission are obviously involved. The role of key persons or gate keepers or the power elite is crucial in such command structure-like operations.

For example, an order can be given to effect a change, or funds can be specifically allocated for installation of a given innovation. Supporters of normative-reeducative strategies believe that power approaches are all too frequently counterproductive to harmonious working relationships.

From this categorization, and from what has been said about the change process, certain crude guidelines may be deduced. Different strategies are geared for special users. The value systems of the change agent and client, the assumptions the change agent makes about the change process and about the client, and the special circumstances surrounding the client or target system should markedly influence the type of strategy to be adopted.

*Some Examples of Change Strategies.* E. M. Rogers (in "The Communication of Innovations in a Complex Institution," *Educational Record*, winter 1968) offered some guidelines for accelerating diffusion in a large university, which will serve to illustrate the matter of strategy and which may have relevance to our own areas of concern. His prescription is as follows:

- Develop and select innovations

## Ex-ASAP Member Gains Civil Health Society Honorary Plaque

Dr. Stanhope Bayne-Jones, a 1965 Outstanding Civilian Service Award recipient in recognition of sustained distinguished service to the U.S. Army Scientific Advisory Panel (ASAP), was recently presented an honorary membership plaque by the International and Civil Affairs Health Society.

Dr. Bayne-Jones is a charter member of the society. Honorary membership awards, initiated in 1968, are reserved for those who achieve prominence in international health, particularly in the field of civil affairs.

The presentation was made by Col John D. Winebrenner, 1968 president of the society, at the National Library of Medicine, where Dr. Bayne-Jones continues to do research and writing. One of his most recent publications is "The Evolution of Preventive Medicine in the U.S. Army," tracing the practice of medicine from colonial times to America's preparation for World War II.

Presentation of the Army Outstanding Civilian Service Award to Dr. Bayne-Jones in 1965, by then Chief of Research and Development Lt Gen William W. Dick Jr., honored the noted scientist, physician, teacher, administrator and retired brigadier general of the U.S. Army for his service to the ASAP from 1956 to 1963.



Dr. Stanhope Bayne-Jones



that have a clear-cut, relative advantage. Test their effectiveness under operational conditions before adopting them on a widespread scale.

- Establish an organization to facilitate change and self-renewal in its social structure.

- Establish an organized procedure of informing those at the top accurately and rapidly both of the needs for change at lower levels of the hierarchy and of the actual consequences of attempted innovation.

- Utilize personnel recruitment, selection and training policies that encourage development of a staff which is oriented to innovative approaches. Utilize informal, interpersonal channels of communication to diffuse innovations.

At the 1968 meeting of the American Educational Research Association, Flanagan offered a most sensible outline of an approach for the educational administrator faced with the problem of choosing from among various educational innovations that might be tried out in his system.

His paper represents a look at change from the other side of the fence, for in it he provides the administrator with systematic, general advice on what to consider in selecting, installing, evaluating, extending and improving educational innovation.

*A "Best" Strategy?* The utility of a change strategy is a matter for empirical test. The very nature of technology, let alone the technology of a soft subject matter such as change, is such that it would be surprising to find simple, hard and fast, uniformly proven principles. But we have, nonetheless, a rich variety of things to consider and a structure of sorts which should serve to make our sometimes implicit assumptions much more explicit when settling upon a strategy for change.

*Paradigms of Effecting Change.* One way to present a summation of what we know about change and to indicate how we may become better students and practitioners of the process is to attempt a formulation of a premodel. While this approach contains elements of the tragic and the futile, it has contemporary appeal.

*Criteria for Evaluating Change Models.* My formulation of these criteria is heavily influenced by Chin. Such a list of criteria might include but not be limited to the following:

- a. Provision for mutual recognition of change agent and client system roles. Does it take into account the values and perceptions of each?

- b. Provision of the means for affecting the direction, tempo and quality of the process of change for both the change agent and the client

system. These handles or levers must be alterable or manipulable.

- c. Consideration of the cost of usage. In the modern parlance of the federal government, is the model cost-effective?

- d. Provision of a reliable basis of diagnosing the strengths and the weaknesses of the client system.

- e. Definition of the period of time required for a continuing relationship of the change agent with special reference to the process of client reaction and anxiety, the obstacles discovered and the new supports required (as, for example, demonstrations, training programs, and funding for maintenance of the changed mode).

- f. Assurance that the model can be communicated realistically to the client system, without distortion and without destroying its basis of effectiveness.

- g. Capability to assume its own appropriateness for different client systems. Does the model provide its own criteria for assessing when it is applicable and when it is not?

- h. Usefulness to a variety of change agents of different philosophical persuasions and with different backgrounds of training and experience.

- i. Provision of means by which students of change can detect gaps in theory and practice.

*Types of Change Models.* It is premature to do more than wish for a general model, let alone a general theory of change and changing. Accordingly, researchers have developed a variety of subsystem models, each of which deals with some aspect



ACTOR Victor Jory and Maj Gen H. G. Davisson, White Sands (N. Mex.) Missile Range (WSMR) commander, discuss a "Lichtenberg tree" presented to the well-known actor during filming of "What Price Confidence?" in which he is an actor and narrator. Produced by WSMR's Pictorial and Processing Division for the Test and Evaluation Command (TECOM), the 27-minute picture is an orientation on TECOM's mission.

of the change process or with some specific setting. Understandably, they vary widely in comprehensiveness, complexity and elegance.

There are the beginnings of models (premodels) for: the processes involved in applied R&D, which include elements of the change process; for curriculum or other change at all educational levels; for modifying and improving business and industrial practices; for change in other cultures; for effecting change in community settings; for the roles of the advocate of innovation; for the role of the potential adopter or receiver of the innovation; for the role of the linker (he who travels back and forth over the lonely road between research and practice); for information retrieval systems to facilitate change; and for the collaborative process involving the system and the change agent.

Dr. McClelland identified, at this point in his address to the American Psychological Association, several basic types of organizational change models. He discussed two premodels, an interpersonal paradigm and an interorganizational paradigm. The complete presentation, including diagrams of these paradigms, has been published as HumRRO Professional Paper 32-67. Copies are available from the Defense Documentation Center and also from the Clearinghouse for Federal Scientific and Technical Information under control number AD-677 980.

## *ECOM Inventor Gains Patent For Spectrum Analyzer Device*

Invention of a device for measuring and analyzing electromagnetic signals throughout the radio frequency range of the natural spectrum has gained Otto E. Rittenbach, an Army Electronics Command employee, U.S. Patent 3,398,364.

Rittenbach is an electronic engineer in the Radar Technical Area, Combat Surveillance and Target Acquisition Laboratory, Fort Monmouth, New Jersey.

His invention is described as a spectrum analyzer for comparing frequency components of a complex signal with a variable reference signal, with special advantages for measuring and analyzing low frequencies, at greater speed than present methods.

Applicants of the instrument range through such areas as doppler radar, employing a frequency shift technique for such purposes as detecting moving objects and measuring their speed; also, audio frequencies and distortion caused by such factors as the harmonic frequency content of electrical power line voltages.



## \$7.3 Million Contract Expands AMC ADP Program

U.S. Army Materiel Command data processing capabilities in more than 20 management areas will be "significantly expanded" by the installation of 13 advanced computer systems.

Among these areas are maintenance, production, control, financial accounting, inventory, personnel and payroll, and other accounting functions associated with large supply and maintenance complexes.

The \$7.3 million contract awarded recently to Control Data Corp. provides for lease and installation of advanced computer systems in AMC installations throughout the United States. The new computers will replace leased and government-owned equipment now used in many areas.

The advanced system is an extension of AMC's System-wide Project for Electronic Equipment at Depots

(SPEED) and represents the depot-level of AMC's over-all National Automatic Data Processing Program for AMC Logistics Management (NAPALM).

Contingent upon a successful test of the equipment, Control Data Corp. initially will install a test bed and a prototype facility at Letterkenny Army Depot, Chambersburg, Pa. The test bed will be used by AMC's Logistic Systems Support Center to develop, test and debug standard systems.

Following successful demonstration of prototype performance and systems

operation, the new systems will be installed over an 18-month period at 11 additional AMC depot sites. Target date for installation of all systems is December 1970.

Scheduled to receive the updated equipment are: Red River Army Depot, Texarkana, Tex.; Sacramento (Calif.) Army Depot; Sharpe Army Depot, Stockton, Calif.; Anniston (Ala.) Army Depot; Atlanta (Ga.) Army Depot; Tooele (Utah) Army Depot; Pueblo (Colo.) Army Depot; Tobyhanna (Pa.) Army Depot; New Cumberland (Pa.) Army Depot; and the Aeronautical Depot Maintenance Center, Corpus Christi, Tex.

## WSMR Finds Record Balloon Launch Package

Launching of the world's largest stratofilm balloon to a record height of 160,067 feet above sea level is yielding belatedly the answers to some of the scientists' questions regarding the upper atmosphere.

White Sands (N. Mex.) Missile Range reported Mar. 18 the discovery of the 65-pound instrument package that has been the object of an intensive search since it was parachuted from the balloon last Sept. 11. Virgil Sullivan, Anaheim, Calif., found the package (part of an original 425-pound payload) during a rock hunting trip and collected a \$200 reward.

Harold N. Ballard, coproject manager of the launching of the 587-foot tall (at time of launch) polyethylene balloon, filled with 28.7 million cubic feet of helium, said recovery of the scientific instrumentation it carried has set the stage for the scheduled release of a larger balloon next September.

Ballard is a research physicist with the Atmospheric Sciences Research Office at White Sands. Sharing responsibility with him is Norman J.

Beyers, a research meteorologist with the ASRO, an element of the Army Electronics Command at Fort Monmouth, N.J. The Sept. 11 launching was directed by Arthur O. Korn Jr., U.S. Air Force Cambridge Research Laboratory.

Contents of the instrument package came through seven months of exposure on the California desert in the Lucerne Valley in excellent condition. The plan is to use several of the instruments in the 30-million cubic-foot balloon to be launched in September.

WSMR scientists are analyzing and evaluating information gained from the instrument package, including measurement of the residual radioactive strength of a beta particle dosimeter and an ozone sensor.

Results of the findings, including telemetry reports received during the 18 hours the balloon was in flight, will be published later this year in scientific journals, Ballard said. The balloon traveled across New Mexico and into California, where it was cut loose near Twentynine Palms.

## Army Dietician Makes Outstanding Young Women List

*Outstanding Young Women of America*, 1968 edition, lists a dietician in the U.S. Army Medical Specialist Corps, Maj Marcia L. Turpin, a resident in hospital administration at Valley Forge General Hospital, Phoenixville, Pa.

Upon completion of her residency, she will be assigned to Vietnam as dietary adviser to a medical group. In working toward a master's degree in hospital administration, she served a year at the Medical Field Service School, Brooke Army Medical Center, taking courses at Baylor University.

Maj Turpin is a native of Indianapolis, Ind., and earned her bachelor's degree at Purdue University in 1960,

under auspices of the U.S. Army Student Dietician Program.

After a year of dietetic internship at Walter Reed General Hospital, she remained on the staff one year. Following two tours of duty as chief, Production Branch, Food Services Division, Irwin Army Hospital, Fort Riley, Kans., she returned to WRGH as assistant chief, Diet Therapy.

Among her numerous professional affiliations are the American Dietetic Association, American Hospital Association, American College of Hospital Administrators, and American Home Economics Association. She is a member of Theta Sigma Phi, national honorary sorority for journalists.

## Brueckmann Gets 20th Patent

Dr. Helmut L. Brueckmann, a research scientist in the Institute for Exploratory Research, U.S. Army Electronics Command, Fort Monmouth, N.J., was recently awarded his 20th patent (No. 3,358,287).

Described as a "Broadband Dual-Polarized Antenna," the invention has applications for measuring purposes by serving as an antenna gain standard, and for polarization diversity in radio receiving systems.



New Commanding General Ferdinand J. Chesarek receives the colors of the U.S. Army Materiel Command from General William C. Westmoreland, Army Chief of Staff, during official change-of-command ceremonies, Mar. 10, at Fort Myer, Va. The 55-year-old West Pointer was promoted to 4-star rank as successor to General Frank S. Besson Jr. as CG of the Army's largest command, which operates with a \$25-billion inventory and annually spends about \$13 billion.



## CDC Establishes Directorate for ADP Management Info

A directorate for Automatic Data Processing/Management Information Systems (ADP/MIS) has been established at HQ U.S. Army Combat Developments Command (CDC), Fort Belvoir, Va.

CDC is concerned with three major automation programs for the Army in the 1970-75 time frame—Tactical Operations System (TOS), Tactical Fire Direction System (TACFIRE) and Combat Service Support System (CSs). All three systems will be mobile. The new directorate will manage ADP resources within the command, including facilities at Fort Ord, Calif., and Fort Leavenworth, Kans.

TOS is a conceptual design for an automated system to assist commanders at field Army level, and below, by providing timely, accurate information and intelligence for fire support coordination and consideration in making operational decisions.

TACFIRE's objectives are to increase accuracy, provide better and more rapid use of target information, reduce reaction time, and provide greater efficiency in determining fire capabilities and targets. The system will reduce the time-consuming burden of computations and information processing now performed manually by the artilleryman.

CSs is a program to automate certain areas of personnel management and logistics at all levels of the Army, including Division, Corps and Army Support Brigade, in such areas as administration, medical, financial, military police, supply, transportation, maintenance and engineer construction.

More than 4,000 officers and enlisted men operate under field laboratory environmental conditions at the

CDC Experimentation Command, Fort Ord, Calif., where concepts of organization and operations developed by CDC activities are tested.

Three vans house a computer that measures and records effectiveness of troops and tactics, simulating causes and effects on the battlefield of equipment and actual combat conditions.

At Fort Leavenworth, Kans., a computer fights thousands of battles (war games) a year. Combinations of men and equipment are observed in all environments, under all intensities of warfare, against enemy forces of various mixes of men and materiel.

When results of a simulation experiment indicate a high probability of success for a certain mix of troops

and equipment, field tests or exercises may be scheduled for validation.

The MIS Directorate at HQ CDC prepares data and narratives for every combat development action. Presently there are more than 15,000 such actions and a read-out can be provided on any one in 15 minutes.

Col Charles T. Caprino heads the 80-man directorate, which with its 97-man field office staff will be responsible for tabulating changes in the 168 TO&Es with tens of thousands of line items for which CDC is the proponent. Col Caprino has been comptroller/director of ADP and Programs at CDC since July 1967.

CDC directorates and agencies can be furnished with printouts or punch cards. The ADP/MIS Directorate will furnish the Department of the Army, on a regularly scheduled basis, a master tape from which TO&Es will be printed for worldwide distribution.

Combat Loss and Expenditure Data of selected end items and munitions from Vietnam (COLED-V) are collated at HQ CDC as a responsibility of the ADP/MIS Directorate.

Computers provide loss-rate from data input in a form usable for estimating and planning combat consumption requirements. Data are furnished to HQ DA, U.S. Army Vietnam, U.S. Army Materiel Command and various CDC agencies.

The ADP/MIS Directorate provides a central design agency to accomplish the programing and installation of command-wide ADP systems.

## TOW Demonstrates Accuracy In WSMR Firings for VIPs

Accuracy of the TOW antitank missile in impacting on moving targets was demonstrated impressively to a group of 3-star and 2-star generals in recent test firings when they toured White Sands (N. Mex.) Missile Range. The TOWs tore the center out of two tank-sized targets.

Designed to replace the Army's 106mm recoilless rifle as well as the ENTAC and SS-11 missiles, the TOW can be fired from a ground emplacement, or when mounted on helicopters and a variety of vehicles. Developers say continuing service tests have shown it can destroy any known enemy armor.

Spectators at the recent demonstration included Lt Gen Paul Gygli, commander, Swiss Army General Staff; Maj Gen Robert Stucki, Swiss Army deputy chief of staff, Operations; Maj Gen. R. M. Gleszer, CG, 5th Mechanized Infantry Division, Fort Carson, Colo.; Maj Gen Richard Cassidy, CG, Air Defense School, Fort Bliss, Tex.; and Maj Gen Horace G. Davisson, CG, White Sands Missile Range.

## SCIENTIFIC CALENDAR

3d Annual Wideband Analog Recording Symposium, sponsored by Rome Air Development Center, Griffiss Air Force Base, N.Y., May 7-9.  
6th National Colloquium on Information Retrieval, sponsored by AMC, Electric and Electronic Engineering Co., Special Interest Group on Information Retrieval, American Documentation Institute, and Association for Computing Machinery, Philadelphia, Pa., May 8-9.

Spring Joint Computer Conference, sponsored by AFIPS, Boston, Mass., May 14-16.

Panel Workshop on Biological Research in Malaria, sponsored by OTSG, Washington, D.C., May 14-16.

Symposium on Semiconductor Effects in Amorphous Solids, sponsored by ARO-D, N.Y.C., May 14-16.

23d Annual Power Sources Conference, sponsored by AMC and Interagency Advanced Power Group, Atlantic City, N.J., May 20-22.

8th U.S. Army Operations Research Symposium, sponsored by ARO-D, Durham, N.C., May 21-23.

Anopheline Biology and Malaria Eradication Conference, sponsored by DoD, OTSG, Armed Forces Pest Control Board, and WRAIR, Washington, D.C., May 21-23.

4th Aerospace Mechanisms Symposium, sponsored by Lockheed Missiles and Space Co., University of Santa Clara, and California Institute of Technology, Santa Clara, Calif., May 22-23.

52d Canadian Chemical Conference and Exhibition, sponsored by The Chemical Institute of Canada, Montreal, Quebec, May 25-28.

## Thaddeus Beal Installed as Under Secretary of the Army

Swearing-in ceremonies installed Thaddeus R. Beal as Under Secretary of the Army Mar. 8 and made him successor to David McGiffert, who had served in the post since November 1965.

Announcement of his appointment was included with the news that William K. Brehm will remain as Assistant Secretary for Manpower and Reserve Affairs and that Eugene M. Becker is retained as ASA for Financial Management.

Secretary Beal was formerly president and chief executive of the Harvard Trust Co., Cambridge, Mass., where he has been prominent as a businessman and a community leader.

Graduated from Harvard Law School in 1947 and admitted as a member of the Massachusetts Bar, Beal joined the Boston law firm of Herrick, Smith, Donald and Ketchum. During World War II he served in the Naval Reserve and achieved lieutenant commander rank.



Thaddeus R. Beal



## RDT&E, Procurement Contracts Exceed \$199 Million

A \$31,255,814 initial increment to a \$93,811,550 multiyear contract with FMC Corp. for M113 vehicles was the largest of Army RDT&E and procurement contracts totaling \$199,580,936 from Feb. 9 to Mar. 9.

AVCO Corp. gained \$19,096,652 in four contracts for turbine engine work and one for manufacture of parts for 40mm projectiles.

Three contracts totaling \$12,018,104 with Amron Corp. are for parts for 40mm projectiles, and cartridge cases. Donovan Construction Co., New Brighton, Minn., is receiving \$10,947,000 for projectile parts.

*Contracts under \$10 million.* Electromagnetic Technology Corp., Montgomeryville, Pa., \$9,845,628 for AN/VPS-2 radar sets, installation kits, and miscellaneous repair parts for the Vulcan Air Defense System.

Southern Airways Co., \$7,795,260 for 155mm projectile parts; Niroyal, Inc., \$7,439,459 for explosives and loading, assembling and packing of projectiles; Rulon Co., Chicago, Ill., \$7,430,500 for parts for fuzes; and Mason and Hanger, Silas Mason Co., \$7,016,389 for loading, assembling and packing ammunition, and for support services; Honeywell, Inc., \$5,357,340 for grenade fuzes.

*Contracts under \$5 million.* Philco-Ford Corp., \$4,831,320 (three contracts), for 30mm guns for helicopters and spare parts for the Shillelagh missile system, and for operation and maintenance at the Nha Trang site in Vietnam; and

Skyline Industries, Inc., Fort Worth, Tex., \$4,254,140 (two contracts) for demolition kits; Olin Mathieson Chemical Corp., \$4,192,240 for loading assemblies of 81mm projectiles; and

Boeing Co., \$3,870,914 (two contracts) for rotary-wing heads for CH-47 helicopters and for inspection and repair work; Thiokol Chemical Corp., \$3,642,901 modification for loading, assembling and packing mortar propellants, igniters, flares and ammunition components; and

White Motors Corp., \$3,517,540 for 21½-ton trucks; General Electric Co., \$3,299,970 for 20mm automatic guns and pods; Maremont Corp., \$3,072,800 for 7.62mm machineguns; General Motors Corp., \$3,013,377 for work on the FRG/US Main Battle Tank and for advance production engineering of procurement of ambulances; and

Bell Aerospace Corp., \$2,954,054 for repair of damaged aircraft and for a distance measuring subsystem for a visual airborne target locator system; Bell and Howell Co., \$2,684,405 for fuzes for bomblets; and

K.D.I. Precision Products, Inc.,

\$2,629,125 for parts for 2.75-inch rocket fuzes; Gocorp, Inc., Adrian, Mich., \$2,579,868 for track-shoe assemblies for M113 carriers; Radio Corp. of America, \$2,380,000 for engineering services for Land Combat Support Systems; and

Wells Marine, Inc., \$2,239,830 for delay plungers used with point detonating fuzes; Norris Industries, \$2,238,000 for parts for 152mm projectiles; Sanders Associates, Inc., \$2,206,171 for engineering services for the Forward Area Alert Radar System; and

Bell Aerosystems Co., \$2,180,676 for designing, developing and delivering three prototype surveillance systems for the Hueycobra helicopter; Uni-dynamics/Phoenix Division of Universal Match Corp., \$2,129,400 for 81mm illuminating projectiles.

*Contracts under \$2 million.* Chrysler Motors Corp., \$1,908,197 for cargo trucks; Bauer Ordnance Co., Detroit, Mich., \$1,899,631 for bayonets for M16A1 rifles; Chamberlain Manufacturing Corp., Scranton, Pa., \$1,843,824 for metal parts for 155mm projectiles; and

Western Electric Co., \$1,688,500 for systems analysis studies in connection with the Safeguard Missile System; Dorsett Electronics Co., Tulsa, Okla., \$1,521,593 for receivers, detectors, intrusion detection sets and related



WATERVLIET (N.Y.) Arsenal chief scientist, Dr. Robert E. Weigle, points out feature of a 4.2-inch mortar designed at the arsenal to Dr. Stephen W. Tsai, chief scientist of the U.S. Air Force Materials Laboratory, during the latter's visit for a briefing on activities of the weapons development installation. Dr. Tsai also conducted a seminar for arsenal scientists and engineers engaged in materials R&D. Representatives from the U.S. Army Materials and Mechanics Research Center, Watertown, Mass., also attended. Dr. Tsai is the editor of the *Composite Materials Journal*.

manuals; and

Firestone Tire and Rubber Co., \$1,404,214 for road wheel disc assemblies for combat tanks; L. E. Mason Co., Hyde Park, Mass., \$1,395,632 for metal parts for bombs; Goodyear Tire and Rubber Co., \$1,384,962 for track shoe assemblies for vehicles; and

International Harvester Co., \$1,232,749 for gas turbines and pump assemblies; Bulova Watch Co., \$1,213,539 for parts for fuzes for 2.75-inch rockets; Penland Paper Converter Corp., Texarkana, Tex., \$1,180,641 for fiber containers for 4.2-inch mortars; and

Grumman Aircraft Engineering Corp., \$1,179,000 for modernization of OV-1A Mohawk aircraft; Pace Corp., Memphis, Tenn., \$1,159,259 for photo-flash cartridges; Ordnance Products, Inc., \$1,150,906 for hand grenade fuzes; and

Raytheon Co., \$1,139,696 for engineering services for the basic Hawk missile system; Clevite Corp., Cleveland, Ohio, \$1,116,916 for engine seals for UH-1 helicopters; and Hughes Tool Co., \$1,042,800 for disassembling, inspecting and repairing damaged OH-6A helicopters.

## Graphic ADA Exhibit Depicts Army Air Defense Evolution

A 3-part exhibit depicting the development cycle and arsenal of the Army's air defense is making the rounds at Army-industry conferences, civic events, military centers and museums, and a wide variety of military-oriented association meetings.

Designed and constructed by the Air Defense Agency at Fort Bliss, Tex., the exhibit includes models of Nike-Ajax, Chaparral, Vulcan, Sprint, Redeye, Hawk, Hercules and SAM-D missiles. Photographic displays show air defense evolution from World War II and a glimpse into the projected future.

A graphic model illustrates the developmental cycle that precedes production of new weaponry, where hardware and doctrinal requirements are defined for the future Army through the 1990s.

A third part of the exhibit is a mock-up of a missile systems control board in a tactical operations center with target identification, acquisition and firing codes. The new FAAR (Forward Area Alerting Radar System) also is shown.

Information on availability of the air defense exhibit can be obtained at the Air Defense Agency, Telephone 915-568-3391, or the Information Office at U.S. Army Combat Developments Command, Fort Belvoir, Va., Telephone 703-664-1455.



# U.S. Army Helps Chile Design, Procure Dental Vans for Remote Areas



Chilean Dental Van

In response to a Chilean government request for assistance in providing modern dental service for Chilean army units in remote places, frequently in areas where only pack animals venture, the U.S. Army has helped design and procure four new dental vans.

Under provisions of the Military Assistance Program of the Department of Defense, the U.S. Army Surgeon General furnished personnel with the technical know-how to design the dental vans for the rare environment in which they will operate.

Chile's Andes mountains, reaching to a maximum of 22,000 feet altitude, comprise about one-third its land area. Between the Andes and the coastal ranges is a desert, a combination that presents a great range of air pressure and temperature extremes in which the dental vans operate.

Designers responded successfully to this challenge and then turned their attention to the installation of dental equipment to satisfy requirements for

movement under rough-terrain conditions without resulting in damage to extremely delicate instruments.

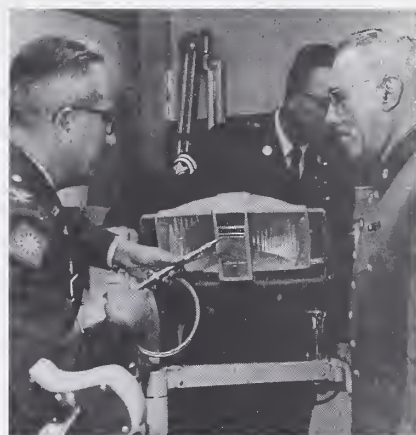
The vans contain autoclaves, high- and low-speed air turbines and evacuating systems, and X-ray units complete with dark room. They also feature indirect overhead lighting, acoustical tile, and modular cabinetry.

Air conditioning and heating provide comfort in the extreme temperatures. While self-sustaining, with their own power system and water supply, the dental vans may also be served by locally available electricity and water sources.

A U.S. Army dentist and an equipment specialist have instructed the Chilean Army dentists in use and maintenance of their new equipment. Chilean Army dentists were enthusiastically impressed, during a "shakedown" trip, with the capability of the equipment and vans.

Col Leonard K. Schreiber, Southern Area Command Dental Surgeon for the U.S. Army, was present at the dedication of the vans. He commented:

"I cannot praise these clinics too



Southern Area Command Dental Surgeon Col Leonard Schreiber explains workings of air-powered drill installed in Chilean vans to Col Jose Plescoff of the Chilean Army staff.

highly. They are really superb. They made a tremendous impression on all who saw them, and have certainly made a contribution to international good will. Everyone who had a hand in this project can certainly feel proud of the achievement."

## Russo Succeeds Gauvreau as President of USAADB

President of the U.S. Army Air Defense Board (USAADB) became the title of Col Joseph Russo on Mar. 3 when he succeeded Col David G. Gavreau in a change of command ceremony at Fort Bliss, Tex.

Attendees included Maj Gen Frank M. Izenour, CG, Army Test and Evaluation Command (USATECOM); Maj Gen Richard T. Cassidy, CG of Fort Bliss; Brig Gen Jack A. Rogers, assistant commandant, Air Defense School, and Col Joseph Long, acting CO, Army Training Center, Fort Bliss.

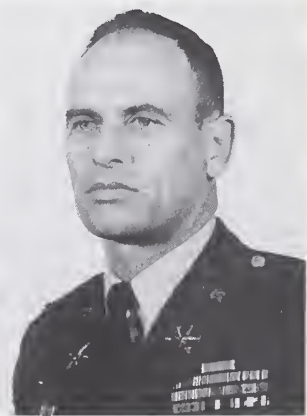
Col Russo has served as deputy president since 1968. Col Gauvreau's new assignment is with the office of the deputy chief of staff, Operations, HQ Air Defense Command, Colorado Springs, Colo. Prior to the USAADB assignment, he was executive to the Chief of Research and Development, HQ DA.

Col Russo, a 1945 U.S. Military Academy graduate, completed two years of graduate work in nuclear physics at the University of Virginia after World War II. He reported to Fort Bliss in 1950 for his first tour of duty as an instructor in Radar and Special Weapons with the former Anti-Aircraft and Guided Missile Branch, Artillery School.

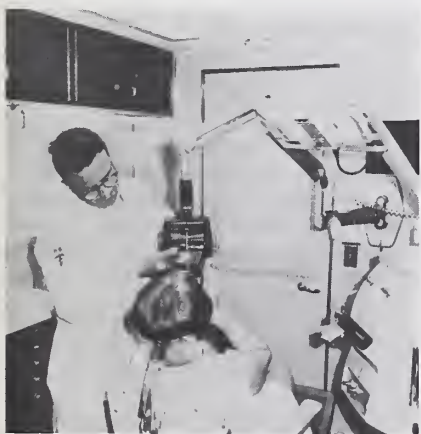
Assigned to Korea in 1959, he returned to the Defense Atomic Support Agency at the Pentagon. In 1964 he returned to Fort Bliss to command the 6th Battalion (Hawk), 56th Artillery, supervising its conversion as the first Hawk battalion deployed to Vietnam.

He returned from combat duty there to serve at Fort Bliss as chief of the Field Manual Branch, U.S. Army Combat Developments Command Air Defense Agency, until assigned to the USAADB.

Col Russo has attended the Command and General Staff College, various artillery, missile and nuclear courses, and the Armed Forces Staff College. He holds the Legion of Merit and the Vietnam Service Medal with three Bronze Stars.



Col Joseph Russo



Dental vans are equipped with X-ray equipment and dark-room facilities.





**MERITORIOUS SERVICE.** Benjamin Goldberg received the Meritorious Civilian Service Award (MCSA) from Maj Gen William B. Latta, CG of the U.S. Army Electronics Command (ECOM), Fort Monmouth, N.J., for management of the Army's night-vision R&D program, August 1967 to August 1968.

Goldberg has been a civilian employee for 27 years at Fort Belvoir, Va., where he is acting director, ECOM Night Vision Laboratory.

"His technical background, experience as a science administrator, and aggressiveness in program management," the citation states, "resulted in significant technical gains that dramatically enhanced the Army's night combat abilities."

Picatinny Arsenal Commander Col Roger Ray recently presented the MCSA to Karl G. Ottoson, chief, Technical Services Laboratory, for his "exceptional contribution . . . an achievement of profound ramifications," 20 years ago, as the inventor of Composition C-4 plastic explosive.

This versatile demolition can be used in any environment and can be attached to any surface, including

materials underwater, and is particularly suited for special warfare tactics. Security restrictions prohibited earlier revelation of the composition and the recognition of Ottoson for a "superlative feat."

Henry Handler, Army Materiel Command (AMC) technical relations adviser, has received the MCSA for the second time in three years. General Frank S. Besson Jr., AMC commander until Mar. 10, presented the award for "outstanding leadership and guidance in complex and diversified engineering and related areas."

A World War II veteran, Handler retired from the Reserve in 1964 with the rank of lieutenant colonel. From 1948 to 1962 he served as a general engineer and special assistant for technical relations with the Office, Chief of Ordnance. He joined AMC in 1962 and has served to the present as the technical relations adviser to General Besson, and in 1966 received a Certificate of Merit from the National Security Industrial Association.

**SILVER STAR.** Lt Col Henry L. Davisson Jr., staff officer with the Technical and Industrial Liaison Office, OCRD, received the Silver Star for gallantry in action during his previous assignment as CO of the 2d Battalion (Mech.) 2d Infantry, 1st Infantry Division in Vietnam.

**LEGION OF MERIT.** Col Dan Crozier, CO of the U.S. Army Medical Research of Infectious Diseases at Fort Detrick, Md., presented the LOM

and a Certificate of Appreciation to Lt Col William R. Beisel when he recently retired from the Army. Dr. Beisel is now a civilian scientific adviser to Col Crozier.

Since receiving his MD degree from the Indiana University School of Medicine in 1948, Dr. Beisel has received numerous awards and honors in clinical and medical research. In 1966 he was honored at the Army Science Conference for a paper on research in infectious diseases. In 1967 he received the Association of Military Surgeons Stit Bronze Plaque for outstanding contributions to medicine.

He also was awarded the Army Medical Corps "A" Prefix rating for outstanding achievement in internal medicine. This is the highest award that can be received in recognition of professional attainment within the U.S. Army Medical Department.

Col Walter E. Rafert, CO, Small Arms Systems Agency, Aberdeen (Md.) Proving Ground, received the LOM for duty from June 1966 to October 1968 as assistant director of Developments and as chief of the Combat Arms Branch, Combat Materiel Division, OCRD.

Lt Col Florian O. Cornay received the LOM for serving from August 1967 to December 1968 in a succession of challenging and responsible positions with the 30th Artillery Brigade (Air Defense), U.S. Army, Ryukyu Islands. He is now assigned to the Physical and Engineering Sciences Division, U.S. Army Research Office.

**CERTIFICATE OF ACHIEVEMENT.** John W. Rathjen, acting chief of the 2.75-inch Rocket Branch, Quality Assurance Directorate at Picatinny Arsenal, received a Certificate of Achievement from General Creighton W. Abrams, head of the U.S. Forces in South Vietnam.

Rathjen earned the commendation as a member of the 2.75-inch rocket system new equipment team that trained Army aviation units in South Vietnam in the use of the WDU/4A/A (flechette) warhead in the latter part of 1968.

**SPECIAL ACT AWARD.** Lester A. Griffin, a munitions engineer with the U.S. Army Munitions Command, Dover, N.J., received an Army Special Act or Service Award of \$1,000, under the Army Incentive Award Program, for outstanding achievement as a member of the Quality Assurance Directorate.

The award cited Griffin for his "vision, dedication and leadership, which contributed materially to the development of a device that proved to be a key component in the economical production of large quantities of 60mm and 81mm mortar ammunition" needed in the Southeast Asia conflict.

## AFMA Acclaims Besson for DoD Management Improvement

General Frank S. Besson Jr. is the recipient of the National Capital Chapter, Armed Forces Management Association's first "Gold Medal for Improvement of Management in the Department of Defense."

Former Army Chief of Staff General Harold K. Johnson (USA, Ret.) presented the award at the National Capital Chapter's first annual award meeting in mid-March at Fort Leslie J. McNair, Washington, D.C.

General Besson was succeeded by General Ferdinand J. Chesarek Mar. 10, after serving seven years as head of the organizational group and then as CG of the Army Materiel Command. He is now chairman of a new Department of Defense Joint Logistics Review Board, established to study worldwide logistics systems in support of the war in Vietnam.

The citation accompanying the award commended General Besson for "outstanding achievements, displaying outstanding leadership, innovation and management skills, which have significantly improved efficiency, effectiveness and economy in employment of our National Defense forces."

Cited also were "a highly developed ability to communicate with all echelons of the military establishment and industry and, second, his long and varied service in some of the most difficult and challenging positions to be found in the world today . . . and an understanding of management techniques mastered by few men."



**FORMER CHIEF OF STAFF** General Harold K. Johnson presents first Gold Medal of the National Capital Chapter, AFMA, to General Frank S. Besson Jr., first commanding general of the U.S. Army Materiel Command.



## Labor Half-Done After 3 Years Effort

"Builder of a perfect town" might be the proud boast of Lt Col Frank Creighton, chief, U.S. Army Missile Command's National Inventory Control Point, Supply and Maintenance Directorate, without stretching a point in the claim—except in size.

Hobbies sometimes can turn into horrible fiascos, in one way or another, but Col Creighton has made the result of his avocation a real work of art—a miniature town, a faithful replica in minutest detail of the real thing as it might be viewed along the border between France and Germany.

Hobbies also can become exceedingly time-consuming, as evidenced in his case by three years of tedious, painstaking work to reach the halfway point of the final objective.

An elaborate church, perfect down to such details as candles at the altar, a hotel with tiny chairs and tables on the terrace, a shepherd's farm-home and barn, a rail station and residences are included in the half of the town he has almost finished. A castle under construction is located on a hill overlooking the town—as castles in medieval cities traditionally do.

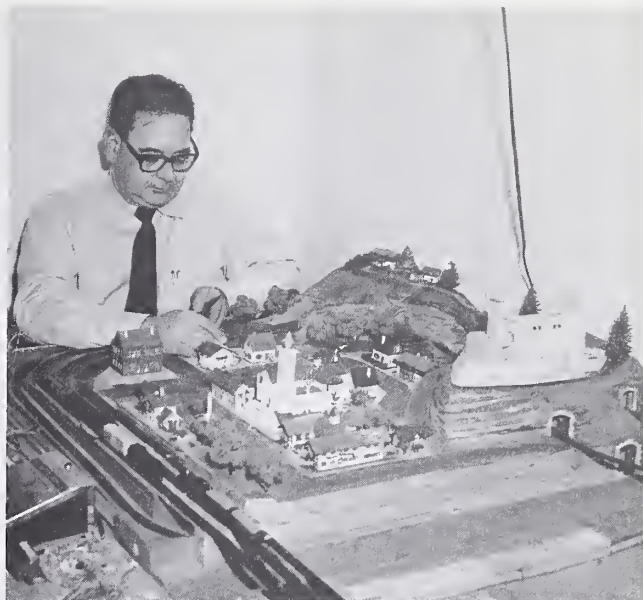
The church alone, took 1,200 hours to build, and the hotel consumed about 400 hours. Col Creighton does all the designing himself; then, using a razor blade, he cuts the pieces to size based on his drawings. His materials are balsa wood or cardboard, depending on which one is more suitable. He uses a razor blade to draw the miniscule lines to make a surface look like a brick wall. The leafy part of trees is made of sponge and colored.

An elaborate network of rail lines runs around the town and through tunnels. Started four years ago, the project was interrupted by his tour of duty in Vietnam—"I took it with me but never unpacked it, because there was no time for hobbies over there."

Col Creighton plans to cover as much area with other structures as he has completed, with a river running through the middle of the town. The first small model city he built was destroyed during two Army moves, he said, so he has a packing case for this one to safeguard it in any move. The case serves as the stand to hold the city now.

He first became interested in the railroad part of the project when the Creightons' son, now 24 and an Army officer, was a little boy playing with his toy trains. That involved the colonel in building a set-up for the trains, and that led to building a town. Then, after seeing buildings in Europe, he was inspired to start his current project.

"It's an inexpensive hobby," he commented. "I'd estimate it averages about \$4 a week. The railroad equipment is valued at about \$100, is N gauge and, until recently, was produced only in Europe."



Lt Col Frank M. Creighton relaxes with hobby of building a miniature replica of a town that might be viewed along many points of the border between France and Germany.

The little town and the railway network are not the colonel's only hobbies. He is writing a tourists' guide to France.

"When we were there and wanted to visit some of the old buildings," he explained, "we could find out nearly everything about their architecture but nothing about who had lived in them, or used them, or how.

"So we started researching in libraries and compiling information

about each place that is a tourist attraction. It makes a place so much more interesting if one knows the human side of the story."

Col Creighton is spending his second tour at Redstone Arsenal. Besides these hobbies, he finds time for golf and keeps up with an active family of five children—the Army officer son, a married daughter, a daughter in college and two daughters at home.

## NRC Appoints Organic Chemist to Study at Natick Labs

Dr. Martin G. Ettlinger has been appointed a National Research Council senior visiting research associate at the Army Natick (Mass.) Laboratories.

Recognized for his research on plants, he will serve in the Organic Chemistry Group, Pioneering Research Laboratory. His studies will involve properties of synthetic vitamin-C-like compounds, and the relation between chemical composition and botanical classification of plants.

While at Natick he will be aided by a concurrent appointment as an Honorary Research Associate of the Gray Herbarium, Harvard University, a world center for the botany of the mustard family of plants.

Dr. Ettlinger received a BA degree in 1942, master's degree in mathematics in 1943 from the University of Texas, and a PhD degree in organic chemistry at Harvard University in 1946.

During World War II, he served at Harvard University on two civilian war research projects, the synthesis of cortisone, and antimalarial drugs.

As a Jewett Fellow of the Bell Telephone Laboratories, he studied at the California Institute of Technology (1946-47) and was a Junior Fellow at Harvard University from 1947 to 1950. He was assistant and associate professor of chemistry at Rice University (1951-65) and has authored 37 scientific papers.

In Denmark for two years prior to accepting appointment to Natick, he coauthored a paper on "Sulfur Compounds in Plants," lectured on physical organic chemistry at the University of Copenhagen (where he plans to return in 1970) and was a visiting professor at the Univ. of Aarhus.



Dr. Martin G. Ettlinger



### 3 Women Prove Merit as Test Support Specialists

Three women employed at the headquarters of the U.S. Army Test and Evaluation Command, Aberdeen Proving Ground, Md., have found that working in what is normally a "man's world" field of endeavor can be highly successful and rewarding.

All three carry the title of test management support specialist and there are five men who have this same title in the eight testing directorates under TECOM.

Actually the title is a salaried euphemism for a jack-of-all trades, a do-it-all administrative assistant. They must keep tabs on the whereabouts and status of anywhere from 150 to 600 test projects in their departments, in programing and budgeting, and act as liaison to other government branches.

Job description functions of a support specialist invariably end with the catch-all "performs other duties as assigned," explained Mrs. Evelyn Kollmar, support specialist for the Aviation Materiel Testing Directorate. "The 'other duties as assigned' is often 95 percent of my work."

One does not have to sit and talk with one of these women for very long before someone from their departments will stop and ask for help.

Col Raymond E. Johnson, director of the Aviation Directorate, said of

Mrs. Kollman: "It would be terribly difficult to function without her."

The support specialists must continually watch their directorate's test projects, and help keep them coordinated with the commodity commands under the Army Materiel Command, with the test centers, and sometimes with other branches of service.

Mrs. Marjorie A. Brinegar, support specialist for the General Equipment Materiel Testing Directorate, watches over nearly 600 projects, constantly checking to make sure each project is where it should be, or rescheduling it.

Budgeting and planning is also an important function of the support specialist's job. Mrs. Elizabeth A. Wiggins, of the Electronics Materiel Testing Directorate, helps manage the funding for the 150 projects under her control, plus programing for projects five years ahead.

The fact that they are women in these men-sized jobs doesn't seem to bother the women or their male coworkers.

"They made me an 'honorary man' when I came here," said Mrs. Wiggins, who worked seven years at the Arctic Test Center (ATC), Fort Greely, Alaska, before she came to TECOM as a specialist in September 1968.

Mrs. Brinegar said she was slightly apprehensive when she accepted a



**TEST MANAGEMENT SUPPORT Specialists (from left) Mrs. Marjorie A. Brinegar, General Equipment Materiel Testing Directorate, Mrs. Evelyn Kollmar, Aviation Materiel Testing Directorate, and Mrs. Elizabeth A. Wiggins, Electronics Materiel Testing Directorate, U.S. Army Test and Evaluation Command HQ.**

position nearly 4½ years ago as the first of HQ TECOM's women support specialists. Since then it has become an intro-office jollity that she is "one of the boys." The term is equally common to these women, however, since all of them have long worked for the Army.

Mrs. Wiggins was a budget analyst in the comptroller's office at ATC. She had accompanied her husband to Alaska, where he worked in the water treatment department at Fort Greely and her job grew as TECOM grew until she finally moved into her current position.

Starting in 1955, Mrs. Brinegar worked as a production control clerk in the Materiel Testing Directorate at Aberdeen, then known as the Development and Proof Services. She later became an administrative specialist.

Mrs. Kollmar worked in data processing, budget and programing for eight years at Aberdeen Proving Ground, have daughters, 11 and 15.

All three are raising families in addition to "doing a man's job." Mrs. Wiggins, 41, a widow, has a 20-year-old daughter working at Fort Greely, and a 13-year-old boy in Bel Air, Md. Mrs. Kollmar, 49, also a widow, has two daughters, one attending the University of Maryland and the other working at the Goddard Space Flight Center, Greenbelt, Md.

Mrs. Brinegar, 35, and her husband, who works in the Technical Support Directorate at the proving ground, have two daughters, 11 and 15, in Aberdeen.

All in all, their expertise has proved invaluable to the functioning of TECOM, and is further proof of the ever-increasing role women play in Army research and development support activities.



**Bernard B. Scheps**



**Troy A. Smith**

### SARS Fellowships Recognize USAETL, MICOM Employees

Secretary of the Army Research and Study (SARS) fellowships approved recently for Bernard B. Scheps and Troy A. Smith will fund one-year special studies to increase their career potential for in-house laboratory assignments.

Scheps was selected for outstanding work as chief, Geographic Information Systems Branch, U.S. Army Engineer Topographic Laboratories USAETL, Fort Belvoir, Va. The fellowship will support research at the Universities of Maryland and Kansas, as well as at USAETL. He also will visit other U.S. Government and industrial laboratories to work on "Terrain Data Potentials of Parallel Image Computer Concepts."

Smith has been a certified professional engineer in the State of Virginia since 1948 and is an aerospace engineer with the Structures and Mechanics Laboratory, U.S. Army Missile Command, Redstone Arsenal, Ala. He started his performing research project in January at the University of Michigan. Titled "Response of a Truncated Right Circular Cone Under Impulsive Loadings and with Arbitrary Boundary Conditions," the study involves conical sections of missiles being subjected to blast loadings.

The SARS Fellowships Program requires submission of detailed technical reports upon completion of study and research projects.



## PLASTEC Roles Increases With New Uses for Plastics

More than 1,000 government specifications relate to plastics and the Plastic Technical Evaluation Center (PLASTEC) at Picatinny Arsenal, Dover, N.J., gets questions about practically every one of them.

PLASTEC is a modern, high-speed information analysis center that collects, evaluates and distributes technical information for use of all U.S. Government and contract-related agencies in the field of plastics.

Five materials specialists, who comprise PLASTEC's staff, can draw on the talents of researchers, engineers and technicians of Picatinny Arsenal's large plastics laboratory. PLASTEC aspires to coverage of the entire plastics and polymer field but has concentrated activities on reinforced plastics in electrical and electronic applications, plastics in packaging, and plastics in mechanical goods.

The Defense Department has assigned to the Army the operational responsibility for PLASTEC, which also serves the Navy and Air Force as well as the National Aeronautics and Space Administration, other U.S. Government activities, and their contractors and suppliers. Its primary function, analysis and evaluation of information, distinguishes it from a normal technical library.

Direct requests for studies determine the specific areas of PLASTEC's activities. The center long ago spotted a neglected area of information—the wealth of technical knowledge offered at conferences in this country and abroad, and often published in very limited editions of preprints or proceedings.

As a guide to this information, the center introduced an annual subject index, bibliography and code description of plastics papers. Reports tell

what has been presented on a particular subject and (by means of the code) what type of coverage is given, including the source, author and his affiliation.

PLASTEC furnishes reports on specific techniques such as flake glass laminates, electrical encapsulation, package-cushioning, filament winding and others. These are largely state-of-the-art studies covering what has been and is being done. Some PLASTEC studies do not detail particular techniques but are of definite assistance to the design engineer in selection of materials.

The library contains more than 11,000 documents, mainly reports on contract studies for government agency projects. They are selected for call-in from various accession lists and from current awareness printouts

from the Defense Documentation Center.

Library holdings are incorporated in a continuing printout system that provides for each item a citation and abstract. Although no loanout system is set up, defense contractor personnel can arrange visits for search and study.

Specialists, most of whom came to PLASTEC from industry, evaluate information collected. Since rapport with industry is vital to operation of the center, they continue to work with industrial people in their particular fields. Information is gathered also in frequent meetings with plastics engineers in Picatinny Arsenal's materials laboratory.

Headed by Harry Peibly since it was organized in 1960, PLASTEC is one of 28 Defense Department information analysis centers set up as authoritative sources to assist in accomplishing defense programs.

## Dr. Hitchcock, Geographer, Former ASAP Member, Dies

Dr. Charles Baker Hitchcock, 63, known as one of the world's leading geographers and map-makers, and as a former member, Environmental Sub-panel of the U.S. Army Scientific Advisory Panel (ASAP), died Mar. 26.

Dr. Hitchcock served as director of the American Geographical Society from 1953 until ill health forced him to retire in 1966. He lived at Pound Ridge, N.Y. From 1959 to 1961, he was president of the Explorer's Club, and was known widely for expeditions he led into the "Green Hell" region of Venezuela and remote areas of Columbia, as well as into other parts of Latin America.

In 1961, he received the Outstanding Achievement Award of the Association of American Geographers and was elected to the council of the American Geographical Society. The

Samuel F. B. Morse Medal "for encouragement of geographical research" was awarded to him in 1966. The following year he received the Explorers Club Medal.

One of his contributions to the ASAP was a recommendation that led to Army publication of the worldwide series of books titled "The Ecology of Malnutrition—Studies in Medical Geography" by Dr. Jacques M. May. Eight volumes have been published and funding has been arranged for remaining world coverage.

Dr. Hitchcock also was responsible for editing the monumental "Millionth Map" of Hispanic America, comprised of 167 sheets. This is the only coverage of any continent at a scale of 1:1,000,000 which follows the standards established by international agreement.

## IKE, AS WE LIKE

### ... TO REMEMBER HIM

WHEN THE GREAT HEART of General Dwight D. Eisenhower stopped beating at 12:25 p.m., Mar. 30, 1969, it could be said literally as well as figuratively that the Heart of a Nation stopped also—in silent tribute to a man respected and loved to a degree few of the makers of history have achieved. For nearly a year (since Apr. 29, 1968, when he was stricken while in California), American people had watched and waited, hoped and prayed that once again he would recover miraculously. Here the 34th President of the United States is shown in the "Ike Jacket" he made famous, and in the prime of his vigor as the Supreme Allied Commander, with the late Prime Minister Winston Churchill, England's "blood, sweat and tears" leader—as they were so often together during discussions of the crises in World War II.





# AUTODIN Adds Automatic Switching Center in Italy

Positioned where Italian inventor Guglielmo Marconi established the world's first radio communications center, near Coltano, Italy, is the newest link in the worldwide U.S. Defense Communications System.

Cutting of a ceremonial ribbon, marking the completion of the Automatic Switching Center as a STRATCOM facility, preceded formal opening of the final link in the Automatic Digital Network (AUTODIN) worldwide system. STRATCOM is the principal manager for design, implementation, installation, testing and acceptance of the switching centers.

Upon acceptance, each center is turned over to the operating military department. Five of the 11 overseas ASCs are operated by the U.S. Air Force, one by the Navy and the other five by the Army.

Brig Gen Thomas K. Trigg, STRATCOM-Europe commander, noted during the ceremony at Coltano:

"Mr. Marconi, as you all know, decided that this area was ideal for his purposes and events proved him right. What he accomplished in the design and operation of his wireless system has its culmination in this miracle of modern technical science which we are here to dedicate today."

AUTODIN is the largest military communications system in the world. The network consists of nine ASC's in the United States plus the 11 overseas

with associated terminals, to provide a reliable, high-speed system.

A multipurpose network with many functions, AUTODIN is handling traffic that includes command and control, operational, logistic and administrative messages as well as many types of data that can be expressed digitally.

Any terminal in the AUTODIN system can communicate with any other terminal anywhere in the world. The ASC's simultaneously interchange traffic with as many as 300 remote subscriber terminals. The unique qualities of these ASC's make it possible for computers at the various terminals to "talk" to each other though using different "languages."

Engineering criteria call for a Flash message to be transmitted from one tributary to another anywhere in the world within ten minutes. By the same standards, an Immediate message will reach its destination in a maximum of 30 minutes, a Priority message in three hours, and a Routine message will be delivered in six hours.

Because of its complete automation each ASC accepts, stores, translates, sorts, records, and retransmits in accordance with the priority assigned by the originator, a mix of information traffic without human assistance.

For example, if the switching center receives a message of each priority (Flash, Immediate, Priority and Routine) at the same time, the messages are forwarded in order of precedence. If another Immediate message is received while the first messages are being forwarded, it is transmitted after the first Immediate message and before any Priority message stored in ASC's memory bank.

## United Kingdom Picks Conway As Kermit Roosevelt Lecturer

General Theodore J. Conway, who served as the first Director of Army Research when the Army Research Office was activated in March 1958, has been appointed the Kermit Roosevelt Fund lecturer to the United Kingdom for 1969. He will address the five British colleges May 5-16.

General Conway is currently Commander-in-Chief of the U.S. Army Strike Command. Lt Gen Sir John Mogg, KCB, CBE, DSO, will be the United Kingdom's Kermit Roosevelt lecturer to the United States.

The lectures are part of an exchange program sponsored by the Kermit Roosevelt Fund, established after the death of the son of President Theodore Roosevelt. Maj Kermit Roosevelt served in both the British and the American Armies.

The multimillion dollar Coltano communications complex was built on the same site used by Marconi for basically the same reasons he chose the location. Centrally located between Pisa and Leghorn, about 10 miles from the sea, the Coltano site is protected from electrical interference by the low hills of Pisa that surround it on three sides. In addition, the aqueous and saline qualities of the soil provide excellent grounding conditions for radio communications.

The remnants of Marconi's buildings, constructed in 1911, are now used by local farmers to shelter their cattle and machinery. Some of the construction difficulties which faced Marconi also posed problems for STRATCOM's engineers.

For example, to keep the whole complex from slowly sinking into the wet clay of the area, the buildings and antenna towers at Coltano are built on 30-foot-long floating piles.

## ECOM Scientist Gets Patent On Thin-Film Capacitor Work

U.S. Patent No. 3,398,067 was granted recently for "A Method of Making Thin-Film Capacitor" developed by Aubrey J. Raffalovich, a physical scientist in the Army Electronics Command's Electronic Components Laboratory.

The patent protects a process of depositing extremely thin films of metals on a ceramic or other type of nonmetallic base to make the advanced type of capacitor.

Raffalovich's application explained that the thin-film capacitor is fabricated by depositing a metal with anodizing properties onto the substrate by sputtering, evaporating under vacuum, or other techniques. The deposit may be between 100 and 5,000 angstroms in thickness.

Anodized in a suitable electrolyte to a predetermined thickness, the film is then aged and reanodized. Then an electrically conductive metal is deposited upon predetermined areas of the film to form the capacitor.

Greatly improved electrical qualities as compared to previously anodized thin film processes are claimed for the new method.

## Natick Labs Develop Space Foods

Apollo program astronauts have had their diet for flights to the moon supplemented recently by two new space foods—chunk-size beef and potatoes, and ham and potatoes—developed by the Army Natick Laboratories.

Together with turkey and gravy, first consumed as part of the Christmas dinner of astronauts aboard Apollo 8, the items supplement the regular planned menu of 32 meals. The menu consists of bite-size compressed foods and freeze-dried rehydratable meals.

Heat-processed in an aluminum foil laminate, the newest additions to the menu are served at cabin temperature of the space vehicle.

Each astronaut approves his own menu, selected from more than 60 space foods developed by the Army Natick Laboratories.

## Olenchuk Named Deputy CO Of Army Munitions Command

Deputy CO of the U.S. Army Munitions Command is the new title of Col Peter G. Olenchuk, who was promoted after serving as MUCOM chief of staff since July 1968. He was CO at Fort Detrick, Md., from October 1966 until reassigned to HQ MUCOM.

Col Olenchuk served with the Life Sciences Division, Army Research Office (1959-61) and then for a year as chief, Chemical-Biological Division, Office of the Chief of Research and Development, HQ DA.

After graduating from the Industrial College of the Armed Forces, he was chief, Chemical Operations, HQ U.S. Military Assistance Command in South Vietnam. Upon return to the United States in 1964, he was assigned to the Plans and Policy Directorate, Joint Chiefs of Staff in Washington, D.C.

Col Olenchuk started his military career as an enlisted man in 1943. He has a BS degree in chemistry from Lebanon Valley (Pa.) College, an MS degree in microbiology from the University of Wisconsin and an MBA from George Washington University.



# CDC Presents Creative Thinking Award to Maj Forrest

If the "Bible" for Army Research and Development had to be inscribed on the head of a pin, two words that could serve to facilitate the feat would be Creative Thinking—which might qualify Maj John B. Forrest Jr. for a future R&D assignment.

The U.S. Army Combat Developments Command's second annual Creative Thinking Award was presented recently to Maj Forrest by Col Everett L. Rea, acting CO of the CDC Maintenance Agency.

The agency is collocated at Aberdeen (Md.) Proving Ground with the Ordnance School, where Maj Forrest was a student when he wrote the award-winning paper on "Recommendations for Overseas Security Operations Doctrine."

In addition to the award of the Creative Thinking bronze statue award, a foot-high replica of Rodin's classic sculpture of The Thinker, Maj Forrest received a \$100 award and a CDC Certificate of Achievement signed by Lt Gen Harry W. O. Kinnard, CG of the CDC.

Maj Forrest, 32, is a graduate of Massachusetts Institute of Technology and served four years during two tours of duty (both extended) in Vietnam. He drew heavily upon this experience in preparing his paper.

Criteria for selection of a paper for the CDC Creative Thinking Award—for which students at the Army Command and General Staff College, Fort Leavenworth, Kans., and officer advanced courses at branch and service schools may compete—are:

"The subject may encompass but is not limited to combat, combat support, concept, doctrine, organization and materiel. It can look to the far future and need not have practicability for application in the present time. It may have Army-wide application or be extremely narrow in scope, such as

treating river-crossing operations."

The Creative Thinking Award is coordinated with CDC's Institute of Combined Arms and Support (ICAS) at Fort Leavenworth and with commanders of other CDC's 7 institutes and 17 agencies. These elements evaluate the competitive papers.

The evaluation process supported the belief that Maj Forrest's paper, which was specially considered by the

## MERDC Establishes New Laboratory, Upgrades Another

Establishment of an Advanced System Concepts Laboratory (ASCL) and redesignation of the Electromagnetic Effects Division as a laboratory were announced Mar. 26 by the U.S. Army Mobility Equipment R&D Center.

Col Edwin T. O'Donnell, commander of the MERDC at Fort Belvoir, Va., said Donald B. Dinger will be acting chief of the Electromagnetic Effects Laboratory, formerly a part of the Electrotechnology Laboratory, after serving as chief of the EED. Maj Thomas H. Huber is ASCL acting chief.

Only a few new personnel other than the 30 employees transferred from EED will be required for the Electromagnetic Effects Laboratory, Col O'Donnell said. Spaces in the ASCL are being filled primarily by personnel from other segments of the center, though the increasing volume of activities and critical nature of some work will require augmentation.

Dinger, at 33, is one of the youngest members of the MERDC technical staff but is serving his 11th year as a Federal Civil Service employee. He began his career a month after graduating from the University of Rhode Island, where he was the outstanding electrical engineering

CDC Institute of Strategic and Stability Operations at Fort Bragg, N.C., "will improve, further define and add dimension to Army doctrine and internal defense and development in overseas security operations." Four recommendations are considered valid for study in doctrine development.

General Kinnard pointed out: "We know that a contest of arms 20 years from now must begin with a contest of minds today. Our Creative Thinking Award will reward inventive people who see this point."

ROTC student in both his junior and senior years. He earned a master's degree in engineering from George Washington University, Washington, D.C., in 1964.

He is a Fellow of the Washington Academy of Science and a member of the Scientific Research Society of America as well as of the Professional Group on Antennas and Propagation, Institute of Electrical and Electronic Engineers (IEEE). In 1965 he was selected for the MERDC commander's Scientific Achievement Medal.

Maj Huber is a 1960 graduate of the U.S. Military Academy with a master's degree in engineering from Purdue University. He served as acting deputy commander of the MERDC until he was named acting chief of the ASCL, and has been stationed at the MERDC since he graduated from the Ordnance School, Aberdeen (Md.) Proving Ground in September 1968.

## Picatinny Arsenal Cosponsors Value Engineering Seminar

Picatinny Arsenal will cosponsor a Value Engineering Executive Seminar for top management defense contractors, May 28 at Bedford, Mass., with the Defense Contract Administration Services in the role of host.

A representative of the Office of the Secretary of Defense is programed as one of the principal speakers, along with Maj Gen J. J. Cody, U.S. Air Force; Everett Knickerbocker, Ammunition Procurement and Supply Agency, Joliet, Ill.; John Bryant, Harbridge House; William Dean, Honeywell Ordnance Division; Robert Kessler, Raytheon Corp.; and Ervin Leshner, Radio Corp. of America.

Other cosponsors are the U.S. Army Munitions Command, Air Force Electrical Systems Division, the Society of American Value Engineers (SAVE) and the Ammunition Procurement and Supply Agency. Joseph F. Ciccio, Picatinny Arsenal value engineer, is handling PA arrangements.



Maj John B. Forrest Jr. (right), a student at the Ordnance Officer Advanced Course, receives the U.S. Army Combat Development Command (CDC) Creative Thinking Award, symbolized by a replica of The Thinker statue, from Col Everett L. Rea, acting CO of CDC's Maintenance Agency at APG.



# Betts Cites Military-Industrial Team Benefits

(Continued from page 2)

the 1980-85 time frame, General Betts pointed to night-vision, surveillance and personnel detection devices "thanks to some 15 years of R&D effort in Army laboratories and in industry," that will give a battalion commander greatly increased operational capability at night even under dense jungle conditions.

Magnetic or seismic sensors, infrared and thermal imagery devices, invisible laser beam detectors, new personnel detection radars, fire-control systems, computer-linked communications and other devices were linked among R&D products that will contribute to operations of U.S. military forces 10 to 15 years from now.

With respect to improved communications that will permit rapid coordination of combat activities, the Chief of R&D explained what may well be forthcoming by use of orbiting satellites, man-portable terminals, laser beam transmission of messages, and an organic telephone-like tactical radio system.

Deep sleep induced artificially by electrical impulses to give combat soldiers 30 to 60 minutes of rest so that they "could awaken fully refreshed and ready for duty" was cited as another possibility. The Army has conducted extensive research in this field for about 10 years and testing of feasibility of using the technique on humans is scheduled this year.

Important advances in Army mobility, such as "walking machines," new designs in wheeled and tracked vehicles, greatly improved helicopters, and jet-powered flying belts to enhance the capability of individual soldiers for special missions, were cited as feasible objectives.

Mobility also might be improved through a terrain analyzer system carried on an aircraft that could fly over terrain under consideration for

## RIA To Honor Local Area Heroes

Rock Island (Ill.) Arsenal, HQ U.S. Army Weapons Command, is preparing to perpetuate the names of its local area heroes in a "Court of Honor" in the John M. Browning Memorial Museum.

The names of heroes from 26 Iowa and 25 Illinois counties will be inscribed in a "Book of Honor" and more than 300 names already have been placed in nomination. Criteria include:

The serviceman or woman must have entered the service from or now be a permanent resident of the area; also, the nominee must have been awarded the Medal of Honor, Distinguished Service Cross, Silver Star, Distinguished Flying Cross, Bronze Star, Air Medal, Navy or Air Force Cross, Commendation Medal with "V" device or the Soldier's Medal, for valorous service in any United States war or conflict.

Friends, relatives or eligible persons desiring information or nomination forms may contact the Office of Information, HQ U.S. Army Weapons Command, Rock Island, Ill. 61201.

future operations. The analyzer sensors would flash back signals to a computer that would give readouts on trafficability of soil, nature of the ground cover and other factors that would determine the type of vehicles that could move in the area.

Among possible fire-control innovations feasible in view of recent developments, he said, is an airborne bullet detector that would enable a helicopter, under enemy fire, to determine instantly the azimuth and range to feed into a computer for automatic aiming and firing of the weapons.

General Betts also discussed the SAFEGUARD System for antiballistic missile defense, and future improvements in its effectiveness that may be expected through continued R&D—improvements "we expect to achieve that will permit the use of very low-yield nuclear warheads, and may even permit use of nonnuclear warheads. . . ."

Turning to R&D benefits in food and medical care for soldiers, he mentioned the "speed kitchen" currently being tested to develop a capability of

bringing the equivalent of home-cooked meals to men in the field. "This kitchen might be a portable pod capable of being carried in an aircraft, or lifted by a helicopter . . . to the troops, wherever they are, and be ready to serve a hot meal within minutes after landing."

Further improvements in complete diagnostic and treatment procedures for the Army in the field, extending considerably beyond those currently being provided by the Medical Unit, Self-contained, Transportable (MUST), can be expected with further developmental effort, he said.

" . . . We just won't be able to afford the development of all of these ideas and many others I have not mentioned," General Betts concluded. "Let's say, for the sake of conjecture, that the cost of development of all of these concepts would be \$500 million a year over the next 25 years."

"But you know, on the basis of experience, that you will have no more than \$300 million a year available. Which projects would you select for development? This, then, is the major problem of Army R&D today; the options are many, the choices must necessarily be few."

# Picatinny Demonstrates EDS&R System Transmission

Exploratory development operation of the U.S. Army Engineering Data Storage and Retrieval (EDS&R) System was demonstrated successfully for the first time in mid-March by network transmission of graphic engineering and program management data.

Telephone lines were used to transmit and receive information between Picatinny Arsenal, Dover, N.J., and Sandia Base, N. Mex. Other network links expected to become operational shortly for testing purposes are White Sands (N. Mex.) Missile Range and HQ Army Missile Command at Redstone (Ala.) Arsenal.

Conceived and carried through various planning and programming phases by the Data Management Division (formerly the Scientific and Technical Information Division), U.S. Army Research Office, the EDS&R project has evolved from 23 task units recommended by the multiple-agency planning Ad Hoc Group established by the Chief of R&D in 1962. EDS&R project development is presently assigned to Picatinny Arsenal's Nuclear Engineering Directorate.

Envisioned is a network system that will "unlock" engineering data generated for specific needs and facilitate use of this data by all Department of Defense engineers and scientists, as well as by various other U.S. government agencies and defense con-

tractors having a certified "need-to-know" relationship.

Exploratory development activities are directed to a system that will receive engineering data in any format, convert it as necessary, code it, store it, and enable the user to find and retrieve it quickly in the form best suited to specific requirements.

The system ultimately is expected to provide microfilm cartridge generation and exchange, computer outputs (magnetic tape to microfilm), and facsimile transmission to users in remote areas via network stations.



Col W. C. Ohl, CO of the U.S. Army Materiel Command Field Office, and Capt R. W. Maiden, chief of the Nuclear Materiel Directorate, Picatinny Arsenal, demonstrate machines used in transmitting and receiving printed matter between Picatinny Arsenal, Dover, N.J., and Sandia Base, N. Mex.



# MRC Planning Advanced Seminar on Graph Theory

An Advanced Seminar on Graph Theory and Applications, sponsored by the Mathematics Research Center, U.S. Army, is scheduled Oct. 13-15 at the center on the University of Wisconsin campus.

Bernard Harris, chairman of the arrangements committee, states that a number of experts in various aspects of the subject will provide expository lectures on recent progress in graph theory and applications.

Persons interested in attending the seminar should write to: Secretary, Advanced Seminar, Mathematics Research Center, U.S. Army, University of Wisconsin, Madison, Wis. 53706.

\* \* \* \*

## By Prof. Bernard Harris

Graph theory, a division of combinatorial analysis, is one of the most versatile branches of applied mathematics, inasmuch as it has been successfully applied to problems in engineering, the social sciences, the physical sciences, operations research, and the biological sciences.

This diversity of application has greatly contributed to a rapid growth of interest in graph theory in recent years. This brief article gives some elementary illustrations of the manner in which graph theory can arise in many diverse branches of human activity.

Before providing these illustrations, we should first state the definition of a graph. For simplicity, we will restrict our attention to finite graphs, specified by two sets—the set  $V$  of vertices  $v_1, v_2, \dots, v_n$  and the set  $E$  of edges  $e_1, e_2, \dots, e_m$  of the graph. Each edge  $e_k$  joins two vertices  $v_i$  and  $v_j$ . It is customary to depict a graph by plotting  $n$  points corresponding to  $v_1, v_2, \dots, v_n$  and if  $(v_i, v_j)$  is in  $E$ , a line is drawn from  $v_i$  to  $v_j$ .

A graph may be either directed or undirected. If it is a directed graph, the elements of the set  $E$  of edges are interpreted as ordered pairs and a directed edge is drawn from  $v_i$  to  $v_j$  (usually indicated by an arrow along the line from  $v_i$  to  $v_j$ ). Generally, when one refers to a graph with no comments as to direction, one is referring to undirected graphs.

Now consider the problem of the electrical engineer who is planning the etching pattern for a printed circuit. The components on the printed circuit are the vertices of the graph and the wiring between two components is the edge connecting the two vertices. The engineer is interested in knowing whether it is possible for him to arrange the components on the printed circuit in such a way that he will not have two wires crossing between components, since this would cause an undesired short circuit.

Mathematically, this is equivalent to asking whether the graph (for his circuit) is a planar graph, a question completely resolved by the Polish

mathematician C. Kuratowski in 1930.

The study of electrical networks has also led to the solution of important combinatorial problems. Kirchhoff's law has played a fundamental role in the solution of "The Problem of Squaring the Rectangle," by C. A. B. Smith and W. T. Tutte; also, in the resolution of the coloring problem for orientable surfaces other than the plane by Gerhard Ringel and J. W. T. Youngs.

The following situation leads to an application of graph theory in social psychology. Select a group of people such as children in an elementary school class, a Boy Scout troop, a social club, or the like. Ask each member of this group to designate those members of the group that he considers to be his friends. Let the people in the group be the vertices of the graph and draw the directed edges from each person to those that he designates as his friends. Graph

theory enables one to determine if the social relationship being considered, friendship in this case, behaves in a random manner, or whether some causal phenomenon is present and some deeper explanation should be sought.

We conclude this exposition with an example from operations research. Assume that we wish to analyze a project whose successful completion requires completion of the individual activities  $a_1, a_2, \dots, a_g$ . There are various relationships connecting the activities, in that some may have to be performed in a specified order, for example, activity  $a_i$  may have to be completed before activity  $a_j$  can be started.

Identify each activity with a directed edge. Let the vertex  $v_1$  be the start of the project and  $v_n$  its completion. The edges starting from  $v_1$  are those activities that can be started immediately. Other edges (activities) will start from other vertices, which must be the terminal points for those edges representing the activities that must be completed before one can commence the activities whose edges start at said vertices. With each edge, a number is associated representing the time required to complete the activity represented by that edge.

The analysis of this type of graph permits one to schedule efficiently the order in which activities are to be performed to minimize the time required to complete the project.

## Dr. El Bisi Returns to Natick Labs After MACV Tour

Dr. Frederick Parrish has succeeded Dr. Hamed M. El Bisi as the U.S. Army Natick Laboratories scientist assigned as a consultant to the science adviser to General Creighton W. Abrams, CG, U.S. Military Assistance Command Vietnam (MACV).

Dr. El Bisi completed a 6-month tour of duty with MACV, serving on the staff of Dr. William G. McMillan, who recently was succeeded by Dr. Nils F. Wilkner as science adviser. About 10 civilian consultants and 20 military project officers experienced in military R&D serve on the staff of the MACV science adviser.

Dr. El Bisi was the only life scientist on a staff composed mainly of physicists, engineers and mathematicians. His work involved problems related to environmental health factors, personal combat and life-support systems, control of biological and materiel deterioration, and other projects to increase efficiency of the Vietnamese forces.

In the Mekong Delta region, he worked with the 9th Infantry Division and with the Third Marine Amphibious Forces, south of the DMZ. He was awarded honorary membership in the 9th Infantry Division by Maj Gen J. E. Ewell, CG, in recognition of his research efforts.

Dr. El Bisi has been associated with the Natick Labs since 1963 as a member of the Food Laboratory staff and is now chief of the Microbiology Division. Formerly a native of Egypt and now a U.S. citizen, he received a BSc degree in agriculture and food sciences at the University of Ein Shams, Cairo. His MS and PhD degrees in food and industrial microbiology are from Illinois University.



Dr. Hamed E. El Bisi





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FLARE

## Chief of R&D Discusses AHFRAC Accomplishments

Army Human Factors Research Advisory Committee (AHFRAC) accomplishments with respect to the human factors and social sciences R&D program were discussed by Chief of R&D Lt Gen A. W. Betts in a recent speech titled "Army Use of Research Results."

Senior representatives from HQ Department of the Army, the Army Materiel Command, Continental Army Command, and the Combat Developments Command comprise the AHFRAC, which was established in 1957 to assist the Chief of R&D. Members hold semiannual meetings to examine the programs and make appropriate recommendations to the Chief of R&D.

The Director of Army Research normally makes the introductory remarks at these sessions, but General Betts took the occasion of the recent meeting to review many of the progress milestones in human factors and social sciences research related to current military requirements.

With respect to this topic, he stated his purpose was to give an evaluation of "the impact of behavioral science R&D on Army Operations; and guidance for future actions concerning these matters."

"Top military commanders have publicly stated, and the world knows, that the U.S. Army battalions and companies in Vietnam today are the best-led, best-trained and conditioned, best-organized and assigned, and best-equipped and supported military force that this nation has ever fielded.

"What you and I also know, and what seems not fully understood and appreciated, is that this enhanced state of effectiveness of our troops in the field is, in significant degree, a result of our investments in behavioral and social science research over the past 20 years."

General Betts listed among the notable advances the Armed Forces Qualification Test that now effectively identifies that proportion of the available population who will not be readily trainable for military jobs; also, the Army Classification Battery that serves to classify the men for more efficient use of their skills and potential for training.

Because of these advances, he said, the Army can use a much higher percentage of the available manpower—"the equivalent of adding from one battalion to one full division to the strength of the Army for each one million men classified."

Among other improvements in utilization of manpower attributable to behavioral and social sciences re-

search, he said, are the Drill Sergeant Program, which has shown "visible results in Vietnam," and the Trainfire rifle marksmanship training technique.

An entirely new concept of human engineering in the development process, that is, designing of materiel with scientific knowledge of how it can be used most simply and effec-

## Army Dentists' Invention Automates Oral Surgery

Letters of patent for an invention that, in effect, helps to automate oral surgery, particularly on tissue growths on the roof of the mouth common to heavy smokers, were issued recently to Army dentists.

Maj Gen Joe M. Blumberg, CG of the U.S. Army Medical R&D Command, presented the patent letters to Lt Col Milton J. Knapp, assigned to the Office of The Surgeon General. Other coinventors are Col John E. Pleasants (USA, Ret. Dental Corps), a former chief of oral surgery at Ireland Army Hospital, Fort Knox, Ky., and John Szekeres Jr., U.S. Army Medical Research Laboratory, Fort Knox, Ky.

Mucosatome is the name given to the specialized cutting tool, which serves effectively to remove the oral growth known as nicotine stomatitis to many smokers. The instrument can be used also to trim the gums to improve fittings for denture wearers.

The removal of such growths or excesses around the gums normally is accomplished by electrosurgery or by use of a variety of spoon-shaped knives called curettes. The power-

tively, has been embodied in A1 Regulation 602-1, titled "Man-Materiel Systems—Human Factors Engineering Program."

General Betts closed with a request to the AHFRAC members to continue to document, by compiling notable examples as further progress is made, how behavioral and social science research is contributing vitally to accomplishment of the Army mission, today and in the foreseeable future.



LETTER OF PATENT for mucosatome is given to Lt Col Knapp, director, Dental Research Division, Research Directorate, U.S. Army Medical R&D Command (AMRDC) by Maj Gen Joe M. Blumberg, AMRDC CO.



MUCOSATOME blade is manufactured in two widths, 4mm and 2mm, pictured above in two views. The U-shaped blade (at right end, top view) reaches out beyond the guards on either side and makes a short stroke forward. The attachment pin (left end, top view) connects to a standard dental handpiece.